Final Remedial Design Report – Phase 2A
East Side Containment Berm
Atlantic Wood Industries (AWI) Superfund Site
Portsmouth, Virginia

Remedial Action Contract 2
Contract: EP-S3-07-07
Work Assignment: 0011-RDRD-03L2

Prepared for

U.S. Environmental Protection Agency
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LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

ARRA	American Recovery and Reinvestment Act
AWI	Atlantic Wood Industries
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
COC	Contaminant of Concern
CVS	Certified Value Specialist
DNAPL	Dense Non-Aqueous Phase Liquid
EA	EA Engineering, Science, and Technology, Inc.
EL	Elevation
EPA	U.S. Environmental Protection Agency
FAR	Federal Acquisition Regulation
FIGG	FIGG Bridge Developers, LLC
H	Horizontal
HDPE	High Density Polyethylene
LLDPE	Linear-Low Density Polyethylene
NAVD88	North American Vertical Datum of 1988
NPDES	National Pollutant Discharge Elimination System
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
PCP	Pentachlorophenol
POI	Point of Investigation
PPIC	Portsmouth Port and Industrial Commission
RA	Remedial Action
RAGS	Risk Assessment Guidance for Superfund
RD	Remedial Design
ROD	Record of Decision
RSL	Regional Screening Level
SAVE	Society of American Value Engineers
TM	Technical Memorandum
TR-55	Technical Release 55

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

V	Vertical
VDEQ	Virginia Department of Environmental Quality
VE	Value Engineering
VPDES	Virginia Pollutant Discharge Elimination System
VPA	Virginia Pollutant Abatement

1.0 INTRODUCTION

EA Engineering, Science, and Technology, Inc. (EA) has prepared this Pre-Final Remedial Design (RD) Report for Work Assignment 0011-RDRD-03L2 under U.S. Environmental Protection Agency (EPA) Remedial Action Contract No. EP-S3-07-07.

This RD memorandum documents the basis of design performed for the East Side Containment Berm and how the RD meets the requirements set forth in the Record of Decision (ROD) (U.S. EPA 2007). This report also documents communication with EPA and local stakeholders.

1.1 PROJECT DESCRIPTION

The Atlantic Wood Industries (AWI) site consists of approximately 48 acres of land on the industrialized waterfront area of Portsmouth, Virginia (Figure 1). From 1926 to 1992, a wood treating facility operated at the site using both creosote and pentachlorophenol (PCP). The facility operations included wood treatment, storage of wood, and disposal of wastes, which lead to the contamination of the site. At one time, the Navy leased a portion of the property from AWI and disposed of waste onsite, including used abrasive blast media and calcium hydroxide sludge. As a result of historical site operations, sediments in the Elizabeth River contain visible creosote. The groundwater and soil at the site are also heavily contaminated with creosote. Creosote contamination previously migrated into a storm sewer and discharged to an inlet of the Elizabeth River at the northeast corner of the site near the former Jordan Bridge (Virginia Route 337). The river contains sludge from production of acetylene sludge and the soils have heavy metals from used abrasive blast media.

Currently, AWI (now known as Atlantic Metrocast, Inc.) operates a pre-stressed concrete products manufacturing facility on the site. Groundwater in this area is not used as a drinking water source.

EPA selected a remedy for the site in the December 2007 ROD which established performance standards for each of the three operable units (OU1, OU2, and OU3) at the Site and specified remedies that addressed soil, sediment, and groundwater contamination.

Due primarily to funding considerations, EPA elected to break the remedial design into separate phases, roughly based on the ROD remedy components. Each phase will have a separate design package to be prepared by EA. Phase 1 designs were completed in 2009-2010; Phase 2 designs are being developed in 2010-2011. Phase 2 of the RD includes the following remedy components and design features:

- East Side Containment Berm
- West Side Containment Berm Completion
- Site Capping
- Stormwater Management/Drainage
- Erosion and Sediment Control
- Dredging and Dredged Material Handling
- Hydrogeologic Analysis
- Groundwater Management
- Operation and Maintenance Plans

This Final Design Report focuses on the East Side Containment Berm (designated by EA as the Phase 2A Design), which will be part of a containment facility to receive contaminated sediments dredged from the Elizabeth River. To date, the major Phase 2A design development and review milestones have included:

- Alternatives Analysis Submittal – July 8, 2010
- Preliminary Design On-Board Review Meeting with EPA – July 29, 2010
- Preliminary Design documents placed on EPA Environmental Science Connector for all stakeholder access and review – August 2010
- Value Engineering Report Finalized – August 25, 2010
- Geotechnical Field Investigation – November 23-24, 2010
- Pre-Final Design Submittal – January 28, 2011
- Final Design Submittal – February 23, 2011

As part of the initial work for the Phase 2A RD, stakeholder input conveyed that minimizing the footprint of the East Side Containment Berm was the primary concern. EA performed the alternatives analysis to evaluate two options for conveyance of stormwater runoff: an open channel swale versus a closed storm drain system. (To further save space, the storm drain was placed within the cross section of the berm.) Following this analysis, it was determined that the swale was a lower cost option compared to the installation of a closed storm drain system; however, the storm drain system was preferred to minimize encroachment onto PER property.

EA proceeded to the Preliminary Design utilizing the storm drain system within the berm to minimize encroachment on PER property and potential impacts with PER's development plans.

In a meeting with PER held on November 29, 2010, EA received a preliminary site development plan for the PER property, which included significant increases in impervious area and intentions to import material to raise site elevations to generate a more usable site and incorporate the East Side Containment Berm and future consolidated dredged sediments into PER's overall site development plans. Based on this preliminary site development plan, the storm drain system option as presented in the Alternatives Analysis and Preliminary Design would have insufficient capacity to convey stormwater runoff generated by the PER property in the post-development condition. The increase in stormwater runoff due to the increase in impervious area would require the installation of an additional storm drain as a part of the PER property development.

Therefore, based on the information provided by PER, the swale option became the preferred option for temporary conveyance of existing condition stormwater runoff. The decision to utilize the swale allows EA to proceed with finalizing construction documents and avoid delays regarding subsequent phases of the RD. The Pre-Final and Final Design submissions of the East Side Containment Berm include the swale design, not the storm drain system to convey stormwater runoff. As PER finalizes their development plans, they will have the flexibility to design and construct a suitable stormwater management system and fill in the temporary swale as they perform their site development.

1.2 STAKEHOLDER COORDINATION

Section 11.2.5 of the ROD (U.S. EPA 2007) requires coordination with the AWI property owner and adjacent property owners to minimize disruptions to ongoing business operations. Specific actions regarding stakeholder involvement include:

- Minimize the disruptions to AWI's ongoing pre-cast concrete manufacturing operations;
- Coordinate with the property owner of 3975 Elm Avenue and the PER property to minimize disruption of redevelopment activities on their respective properties; and
- Coordinate with FIGG Bridge Developers, LLC (FIGG) regarding activities around the former Jordan Bridge (previously owned by the City of Chesapeake).

Substantial coordination efforts have been performed by EPA and EA throughout the Phase 2A design process. Stakeholder input was actively sought by EPA/EA and design considerations were made in response to that input to minimize disruptions to ongoing and future business operations. Coordination was performed with the following stakeholders during design:

- AWI

- The 3975 Elm Avenue Property Owner (on whose property the Phase 2A design is located)
- The PER Property Owner (on whose property the Phase 2A design is located)
- City of Portsmouth
- FIGG
- Virginia Department of Environmental Quality (VDEQ).

EPA/EA performed extensive coordination with many stakeholders through meetings, telephone calls, and e-mails; special efforts and concern were placed on the stakeholders upon whose property the East Side Containment Berm will be constructed. The more significant coordination efforts with the stakeholders are summarized in the following table.

Date	Coordination Description	Stakeholders Included
June 14, 2010	EPA/EA met with property owners to present alternative berm alignments for review and comment. EP ultimately incorporated stakeholder input into the Alternatives Analysis. EA sent CAD files of the berm alternatives to PER for their evaluation.	• 3975 Elm Avenue Property Owner • PER Property Owner
July 9, 2010	The Draft Alternatives Analysis was sent to stakeholders for review and comment.	• AWI • 3975 Elm Avenue Property Owner • PER Property Owner • VDEQ
August 4, 2010	The Preliminary Design was sent to stakeholders for their review and comment.	• AWI • 3975 Elm Avenue Property Owner • City of Portsmouth • PER Property Owner • VDEQ
August 30, 2010	EPA/EA met with stakeholders in Norfolk, Virginia to discuss the Preliminary Design and stakeholder concerns relative to their properties.	• AWI • 3975 Elm Avenue Property Owner
November 29, 2010	EPA/EA met in Portsmouth, Virginia to discuss the Preliminary Design and their concerns relative to their properties.	• PER Property Owner
February 1, 2011	The Pre-Final Design was sent to stakeholders for review and comment.	• 3975 Elm Avenue Property Owner • PER Property Owner • VDEQ

Note: The above table is not meant to be an all-inclusive list of coordination activities.

General descriptions of issues that may impact specific stakeholders and related design modifications are described in the following sections.

1.2.1 3975 Elm Avenue Property Owner

EPA coordinated extensively with the owner of the 3975 Elm Avenue property during preparation of the East Side Containment Berm RD. EPA coordinated access to the 3975 Elm Avenue property for field investigations and reconnaissance during the RD and has begun coordination for property access during the RA as well.

EPA provided design documents during all phases of design (Alternative Analysis, Pre-Final, and Final) to the owner of the 3975 Elm Avenue property to solicit comments. The significant design modifications that resulted from coordination with the 3975 Elm Avenue property owner were:

- The alignment and cross section of the containment berm and the method of stormwater conveyance.
- The containment berm will be constructed as close as possible to the shoreline of the Wyckoff Inlet in order to minimize encroachment onto the 3975 Elm Avenue property.
- The use of a drainage swale to route stormwater runoff around the new berm.

EPA also considered access to the top of the berm and future beneficial use of consolidated dredged material upon completion of the dredged material placement for the owner of the 3975 Elm Avenue property. Accordingly, EPA/EA will provide a drivable transition from the current grade on the 3975 Elm Avenue property to the top of the new land at elevation 10.5 (feet, NAVD 88). The drivable transition will be designed as part of a future RD effort.

1.2.2 PER Property

EPA coordinated extensively with PER Properties (PER), the property owner of the PER property, during preparation of the East Side Containment Berm RD. EPA coordinated access to the PER property for field investigations and reconnaissance during the RD and has coordinated for property access during the RA as well.

EA provided the Phase 2A design documents during all phases of design to PER to solicit comments. Similar to the 3975 Elm Avenue Property Owner, coordination with the PER property owner resulted in:

- The alignment and cross section of the containment berm to be constructed.
- The containment berm will be constructed as close as possible to the shoreline of the Wyckoff Inlet in order to minimize the encroachment onto the PER property.
- The use of a drainage swale to route stormwater runoff around the new berm. This swale will likely be temporary, based on PER's future development plans.
- An expanded Limit of Disturbance during construction of the East Side Containment Berm.

1.2.3 Atlantic Wood Industries

EPA provided design documents during all phases of design to AWI to solicit comments. EPA/EA also coordinated with AWI during preparation of the East Side Containment Berm RD. EPA coordinated access to the west side AWI property to:

- Use existing Stockpile Area A to store any contaminated material that may be generated during the Phase 2A remedial action.
- Continued use as an area for EA's construction trailers.
- Use of the existing drum storage area in Stockpile Area A.

2.0 BASIS OF DESIGN

The basis of design report provides a description of the analyses conducted in the development of the design approach. The following sections provide discussion on the design assumptions, the RA contracting strategy, permitting requirements, and the identification of easement and access requirements.

2.1 SUMMARY AND JUSTIFICATION OF DESIGN ASSUMPTIONS

The following sections provide justification of the design assumptions. The sections are divided into major elements of the design.

2.2 EAST SIDE CONTAINMENT BERM

The East Side Containment Berm will be constructed along the north shore of the Wyckoff Inlet to help contain the contaminated sediment being dredged from the Elizabeth River. The berm will tie into the north end of the Offshore Sheet Pile Wall and extend to the west, ending near the intersection of Elm Avenue and Veneer Road. The berm is designed to match the top elevation (EL) of the Offshore Sheet Pile Wall, +10.5 feet (North American Vertical Datum of 1988 [NAVD88]). The berm is being constructed on the PER and 3975 Elm Avenue properties. Limiting encroachment of the berm on the properties was balanced against the stability of the berm, which required the berm to be aligned upland of the shoreline.

EPA solicited the owners of both the 3975 Elm Avenue and PER properties during preparation of the East Side Containment Berm RD to help determine the most appropriate alignment and cross section of the berm. Stakeholder input on minimizing the encroachment led to the design of a cross section that includes a 4-foot top width with 2H:1V side slopes. Additionally, EA coordinated access to the 3975 Elm Avenue and PER properties for field investigations during this design. The Phase 2A RD includes several provisions to minimize impacts to planned uses of the 3975 Elm Avenue and PER properties:

- The Phase 2A RD specifies the use of low permeability material in construction of the berm to minimize the migration of contaminants in the dredged material to the ground surface on the opposite (northern) side of the berm.
- The Phase 2A RD specifies that the grading on the upland (northern) side of the berm will provide drainage to Southern Branch of the Elizabeth River.

- The Phase 2A RA will include erosion and sediment controls.
- The Phase 2A RA contractors will provide mitigation for all dust generated from construction activities.

2.2.1 Design

Details of the containment berm design are discussed in this section, including:

- Grading/Excavation
- Material

2.2.1.1 Grading/Excavation

The grading and excavation activities associated with the containment berm design include the following requirements:

- Construction of a containment berm to help contain future placement of dredged material.
- Construction of a swale for conveyance of obstructed runoff flows to the Elizabeth River.
- Excavation is required for the construction of the swale to achieve positive drainage.
- Any potential ponding areas created by the construction of the containment berm will be drained via the swale placed adjacent to (just north of) the berm section.
- All earthmoving equipment will be decontaminated prior to leaving the project site.

2.2.1.2 Material

The materials of construction of the containment berm design include the following requirements:

- Contaminated excavated material will be placed in Stockpile Area A on the west side of the AWI site. Uncontaminated material originating from the PER property will be stockpiled on the PER property by the contractor.
- Remaining material needed for the construction of the containment berm section will be clean, imported material meeting low permeability criteria required by the specifications for this project.
- Existing onsite material excavated during the construction may be used in construction of the berm provided it is not contaminated and can meet the specified permeability requirements.

- Based on a constructability analysis, the design of East Side Containment Berm was modified from a low permeability core overlaid by common borrow to a design specifying construction of the entire berm cross section using low permeability material.
- Specifications and standards for temporary and permanent seeding will be included under Erosion and Sediment Control.

2.2.2 East Side Containment Berm Swale

The construction of the berm near the shoreline will create depression areas on the upland side of the berm that will collect storm runoff from rainfall events. Therefore, the cross section of the proposed East Side Containment Berm will include a swale that has been sized to convey the storm runoff obstructed by the proposed berm. The swale will accept the flows from the upland side of the berm and convey the flows to the ultimate outfall at the east end of the berm. The swale cross section will include a stone riprap bottom and linear-low density polyethylene (LLDPE) geomembrane liner over the entire cross section of the swale.

The swale will be graded from elevation +0 (feet, NAVD88) at the east end of the berm at a slope of 0.5 percent to an elevation of approximately +3.5 (feet, NAVD88) where the swale intersects the south PER property line. Existing elevations on the 3975 Elm Avenue property along the toe of the proposed berm slope to the east and will convey small flows toward the swale, eliminating the need for a swale along that portion of the berm. Along the eastern end of the berm the downstream swale elevations are much lower than the surrounding existing ground elevations; therefore, the swale is well defined and has sufficient capacity to convey the pre-development flows.

The proximity to the Southern Branch of the Elizabeth River means the properties are affected by storm surge in the river during large storm events, with the 10-year and 100-year flood elevations in the Elizabeth River at 5.5 feet (NAVD88) and 7.61 feet (NAVD88), respectively. The swale will be hydraulically connected to the Southern Branch of the Elizabeth River, and during large storm events will allow the surface water elevations on the properties to rise and fall along with the River as occurred during the pre-development condition. Therefore, the berm and swale construction will not alter the drainage of the site during storm events.

2.3 EAST SIDE CONTAINMENT BERM DRAINAGE

2.3.1 Hydrologic Analysis

A hydrologic analysis was performed for the site to determine pre-development and post-development discharges for the points of investigation (POIs). From the analysis, estimated runoff volumes and flow rates were computed.

Hydrologic calculations were performed using Natural Resources Conservation Service, Technical Release 55 (TR-55) methodologies. This method requires several inputs that utilize site-specific information including runoff curve number, time of concentration, and rainfall data. The calculation was performed with Microsoft Excel 2007 spreadsheets developed by EA that are based upon the same forms presented in the TR-55 manual.

The curve number is a function of the land cover and existing soil type. Because the site is composed of manmade fills and is considered “disturbed,” the hydrologic soil group was analyzed as a “C” soil. Existing land cover was derived from the survey performed for the site and generally consists of paved areas, buildings, gravel areas, grass, and brush.

The time of concentration was computed using the topographic and land cover information taken from the survey performed for the site. The survey provided the required elevations/slopes and lengths necessary to compute the times for the various flow segments that comprise the time of concentration calculation. Using this information, hydrologic calculations were performed to estimate runoff volumes and flow rates at the site.

All calculations associated with the hydrologic and hydraulic analyses are included in Appendix A.

2.3.2 Software Used

The following software was employed in the hydrologic and hydraulic analysis:

- AutoCAD Civil 3D 2009, distributed by Autodesk, was used in the drafting, electronic topographic model, and volume calculations for the project.
- WinTR-55 was utilized to determine stormwater runoff and flow quantities. It is a single-event rainfall-runoff hydrologic model for small watersheds developed by the Natural Resources Conservation Service. The model generates hydrographs from both urban and agricultural areas and at selected points along the stream system. Hydrographs

are routed downstream through channels and reservoirs. Multiple sub-areas can be modeled within the watershed.

- Autodesk Hydraflow Extensions were utilized in hydraulic calculations.

2.3.3 Pre-Development Drainage Area Descriptions

The East Side Containment Berm will be constructed across two properties: (1) 3975 Elm Avenue, which is currently occupied; and (2) the PER property, which is currently vacant but possesses existing structures and has pending development plans. Each site generally drains north to south toward the Wyckoff Inlet, with a portion of the PER property draining east toward the Elizabeth River. The 3975 Elm Avenue property is covered by buildings and asphalt and concrete pads with some grassed and gravel areas. The PER property has some concrete pads but is mostly covered by grass and dense vegetation. The properties are bounded by Veneer Road to the west, United States Navy property and Baugh Road to the north, the Southern Branch of the Elizabeth River to the east, and Elm Avenue and the Wyckoff Inlet to the south. The location of the East Side Containment Berm construction is illustrated on *Figure 1- Pre-Development Drainage Conditions* located in Appendix A.

POI-1 is the point of investigation for the area tributary to the location of the East Side Containment Berm construction. The majority of the tributary area will not be disturbed during the completion of the berm; therefore, the area boundary will remain nearly identical from pre-development to post-development condition. The tributary area consists of the majority of the PER property and eastern portion of the 3975 Elm Avenue property down to the shoreline of the Wyckoff Inlet. The 10.37-acre drainage area consists of grass and dense vegetation on the PER property, and grass, gravel, and impervious area on the 3975 Elm Avenue property. Most of the tributary area drains to a shallow swale running along the property line between the two properties. The swale conveys flows south through a 15-inch culvert under an old road and discharges into the Wyckoff Inlet. The rest of the drainage area not tributary to this shallow swale sheet flows south into the Wyckoff inlet.

2.3.4 Post-Development Drainage Area Descriptions

This phase of the RD includes the construction of a containment berm along the north side of the Wyckoff Inlet. The earthen containment berm will be constructed with a swale on the upland side to collect and convey stormwater runoff cutoff by the berm to the outfall at the east end of the containment berm. *Figure 2 – Post-Development Drainage Conditions* illustrates the location of the East Side Containment Berm and associated tributary area.

The proposed containment berm will intercept nearly all of the pre-development area draining to POI-1. The total drainage area to POI-1a will be reduced by a negligible amount consisting of the area from the top of the berm to the shoreline.

Investigation and input from the stakeholders has indicated the occurrence of flooding during high frequency storm events around the Wyckoff Inlet extending to the intersection of Elm Avenue and Veneer Road. As part of the design for the East Side Containment Berm and swale, considerations were taken to ensure no increase in flooding takes place as a result of the construction. An inundation analysis was performed for the area to determine the effects of the berm and swale on the flooding. The use of the swale as the conveyance for the stormwater runoff will allow the upland side of the berm to remain hydraulically connected to the Southern Branch of the Elizabeth River. The properties will experience the same inundation in the post-development condition as experienced in pre-development condition with the water surface elevation on the upland side being equal to the water surface elevation in the river.

2.4 GEOTECHNICAL INVESTIGATION

A geotechnical investigation was performed in 2008 along the north shore of the Wyckoff Inlet to determine the need for a sheet pile wall at the east end of the PER property. The results of that investigation are documented in Technical Memorandum (TM) No. 4, "Geotechnical Investigation to Determine the Need for Sheet Pile Wall at the East End of the PPIC Property," Final (EA 2009). This data was reviewed and it was determined that additional geotechnical data was needed in the vicinity of the Phase 2A project area to evaluate the East Side Containment Berm area for stability, settlement, and seepage characteristics.

Schnabel Engineering was subcontracted to EA to perform additional geotechnical investigations and analyses for the East Side Containment Berm RD. They prepared a report documenting the field activities, laboratory analyses, and geotechnical analyses performed from November 2010 through February 2011. The report is included in Appendix B.

2.5 DENSE NON-AQUEOUS PHASE LIQUIDS (DNAPL)

In 2008, a field investigation was conducted by EA to assess the subsurface geology and determine the lateral extent of surface and subsurface DNAPL along the southwest corner of the PER property. Several of the borings along the Wyckoff Inlet contained DNAPL-impacted material. Investigation results are presented in TM No. 1, "Geology and NAPL Distribution at the Portsmouth Port and Industrial Authority (PPIA) Property," Final (EA 2008). This TM is included with the design documents as an attachment to the specifications. To minimize the potential for migration of these contaminants, the swale that will be excavated will be lined with a LLDPE membrane liner. Excavated soil that is visibly impacted by DNAPL will be handled in accordance with the requirements set forth in the specifications and transported to existing Stockpile Area A on the west side of the AWI site.

2.6 EROSION AND SEDIMENT CONTROL

Virginia Erosion and Sediment Control Regulations and *City of Portsmouth Erosion and Sediment Control Ordinance*— In accordance with the regulations, localized flooding, offsite migration of sediment, and stream channel erosion of the existing waterways will be controlled during all land-disturbing activities through implementation of sediment control devices, methods, and installation procedures designed in accordance with both the Virginia Erosion and Sediment Control Regulations and the City of Portsmouth Erosion and Sediment Control Ordinance.

A sequence for the establishment of the erosion and sediment controls is provided on the plans in order to describe how and when the controls should be installed and removed in relationship to construction activities. In addition, incremental and permanent vegetative stabilization of the site is required to promote good ground cover and to minimize erosion. The controls will be removed after final vegetative stabilization of the site is complete.

Erosion and sediment control for the East Side Containment Berm construction includes stabilized construction entrances for access points and silt fence for perimeter control designed according to Virginia erosion and sediment control standards. The use of turbidity curtains is included to reduce the impacts of the construction on the Wyckoff Inlet and Southern Branch of the Elizabeth River.

There is a potential need for dewatering during the excavation and construction process. Provisions for the treatment of contaminated and uncontaminated groundwater and surface water runoff are provided in Specification Sections 01 57 13 - Erosion and Sediment Control and 02 61 13 - Excavation and Handling of Contaminated Materials.

2.7 AMBIENT AIR STANDARDS CALCULATIONS

Air monitoring for both RA and non-RA workers will be conducted during the project when contaminated material is being excavated, handled, or treated. Ambient air standards (risk-based criteria) for non-RA workers have been provided to the Contractor in the Specifications. Ambient air standards were calculated using guidance provided in EPA's Risk Assessment Guidance for Superfund (RAGS) and Regional Screening Levels (RSLs) for Superfund Sites (April 2009). Exposure parameters were taken from the RAGS and RSL guidance, except for site-specific inputs that include target risk and exposure duration. The calculations were performed with Microsoft Excel 2007 spreadsheets developed by EA and are based upon the same equations presented for ambient air inhalation exposure in RAGS and the RSLs.

Ambient air standards were calculated for the soil contaminants of concern (COCs) identified in the ROD (polycyclic aromatic hydrocarbons [PAHs], PCP, arsenic, antimony, iron, and thallium), as well as the BTEX compounds (benzene, toluene, ethylbenzene, and xylenes) due to their presence in groundwater. The target risk was set at 1×10^{-5} since all of the PAHs identified in the EPA RSL Table were included in the calculations. For mutagenic compounds (i.e., a substance capable of causing mutations), an adjustment factor of 10 was utilized to account for the most susceptible receptor (0-2 years). For non-carcinogens, a target of 1.0 was used instead of 0.1 since all of the non-carcinogenic compounds in soil do not have the same target organ. The exposure duration was assumed to be 4 months (the anticipated duration of the East Side Containment Berm construction activities).

All calculations associated with the ambient air standards are included in Appendix A. Contractor requirements for air monitoring, including minimum requirements for onsite and perimeter monitoring, screening levels based on risk, and trigger concentrations for implementing action are provided in the specifications.

2.8 PERMIT REGULATIONS

The following permits were considered in the production of the East Side Containment Berm design:*Virginia Water Protection General Permit Regulation*— A permit will not be required for the stormwater management system; however, the substantive requirements of the permit will be met. In accordance with the regulations, any fill material associated with the stormwater management and/or drainage conveyance systems will be clean and free of contaminants in toxic concentrations or amounts in accordance with all applicable laws and regulations.

Virginia Pollutant Abatement (VPA) Permit Regulation—This requirement regulates the stormwater collected from the surface of the berm adjacent to the Southern Branch of the Elizabeth River, a state surface water. This discharge is required to comply with the substantive requirements of the VPA permit allowing no point source discharge of pollutants to the surface water except in the case of a storm even greater than the 25-year, 24-hour storm; however, a permit is not required for this remediation.

National Pollutant Discharge Elimination System (NPDES), Virginia Pollutant Discharge Elimination System (VPDES) General Permit Regulation and City of Portsmouth Stormwater Management Ordinance—No administrative permitting or review document submissions are required for the stormwater management system from either the Commonwealth of Virginia or the City of Portsmouth; however, the requirements of both the general permit and ordinance will be met during construction activity. In accordance with the regulations, localized flooding and stream channel erosion of the existing waterways will be controlled by managing the post-development stormwater runoff to the extent practicable and equal to or better than the pre-development runoff conditions.

3.0 FINAL DRAWINGS AND SPECIFICATIONS

This section provides the lists of drawings and specifications that comprise the East Side Containment Berm RD.

3.1 CONTRACT DRAWINGS

The contract drawings consist of the following sheets:

Drawing Number	Sheet Number	Sheet Title
T-1	1	Title Sheet
T-2	2	Index Of Drawings/General/ Notes/Abbreviations/Legend
C-1	3	Existing Conditions Key Sheet
C-2	4	Existing Conditions Plan - East
C-3	5	Existing Conditions Plan - West
C-4	6	Proposed Conditions Key Sheet
C-5	7	Proposed Conditions Plan - East
C-6	8	Proposed Conditions Plan - West
C-7	9	Berm Profile And Cross Sections
ES-1	10	Erosion And Sediment Control Plan
ES-2	11	Erosion And Sediment Control Details
ES-3	12	Erosion And Sediment Control Notes

3.2 TECHNICAL SPECIFICATIONS

The following list provides a summary of the specifications for the project.

DIVISION 01 – GENERAL REQUIREMENTS

01	11	00	SUMMARY OF WORK
01	33	00	SUBMITTAL PROCEDURES
01	35	29.13	HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES
01	35	40.00	ENVIRONMENTAL MANAGEMENT
01	35	45.00	CHEMICAL DATA QUALITY CONTROL
01	50	00	TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
01	57	13	EROSION AND SEDIMENT CONTROL
01	77	00	CLOSEOUT PROCEDURES

DIVISION 02 - EXISTING CONDITIONS

02	61	13	EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL

DIVISION 31 – EARTHWORK

31	00	00	EARTHWORK
31	11	00	CLEARING AND GRUBBING

4.0 RESULTS OF VALUE ENGINEERING STUDY

Phase 2A of the RA for AWI is fund-financed and therefore requires a value engineering (VE) screen per Federal Acquisition Regulation (FAR) Part 48. The VE screening evaluates the RD and determines if the design is cost-effective, and the results are summarized in a VE study report. The VE study for the East Side Containment Berm RD took place August 3-5, 2010 following the Preliminary Design submission. The VE study was conducted by Lewis & Zimmerman Associates, Inc. and included a Society of American Value Engineers (SAVE) Certified Value Specialist (CVS) team leader. The VE team used the following six-phase VE job plan to guide its deliberations:

- Information Gathering Phase
- Function Analysis Phase
- Creative Idea Generation Phase
- Evaluation/Judgment of Creative Ideas Phase
- Alternative Development Phase
- Presentation of Results Phase

The following are recommendations and comments that resulted from the VE study. A response to each is also provided.

East Side Containment Berm

1. B-1: Construct the entire berm using a single, relatively low-permeability material.

   Response: This recommendation has been accepted.

2. B-2: Combine East Side Containment Berm and Offshore Sheet Pile wall into one bid package

   Response: This recommendation is not being accepted. The RA for the East Side Containment Berm will utilize funds from the American Recovery and Reinvestment Act (ARRA); and therefore, must be executed under separate contract.

3. B-3: Replace berm design by sheet pile wall.

   Response: This recommendation is not being accepted. The use of a sheet pile wall is significantly more expensive than the containment berm and does not offer significant advantages over the berm to justify the cost.

4. B-4: Use open swale in lieu of underground storm drain system.

   Response: This recommendation has been accepted. The storm drain system was originally proposed to minimize the project's footprint on the 3975 Elm Avenue and PER properties. Through further discussions with those property owners, the swale drainage condition will be temporary until future site development changes the overall drainage patterns on the PER property. The swale is more cost-effective than a storm drain for the temporary condition.

5. B-8: Decrease side slopes from 2:1 to 3:1 and add rip rap.

   Response: This recommendation is not being accepted. Flatter side slopes will widen the berm's footprint unnecessarily increasing the impact on the host properties and are not needed for slope stability based on geotechnical analysis. Riprap is unnecessary for side slope protection.

6. B-11: Replace berm with stacked gabion or Hesco type baskets and line with HDPE.

   This recommendation is not being accepted. This alternative is significantly more expensive than the berm alternative and the project does not require a smaller footprint than the berm alternative provides.

5.0 CONSTRUCTION SCHEDULE

The RA construction schedule will identify the timetable for completing critical tasks and project milestones. EA is currently preparing a Remedial Action Work Plan (RAWP) Addendum to define the construction scope and schedule in more detail. EA anticipates approval of the RAWP Addendum in early March 2011 with award to a subcontractor in mid-April 2011. Onsite construction activities are anticipated to begin in June 2011.

Figure 1 - Atlantic Wood Industries Superfund Site - Remedy Elements
Portsmouth, Virginia

Appendix A

Engineering Calculations

Stormwater Management
Pre-Development

EA Engineering, Science, and Technology

Project: AWI RD Phase II - Final
Project #: 14530.11
Task: A; 211.41
Calculated: JLL Date: 1/4/2011
Checked: Date:

TR-55 Worksheet #2: Runoff Curve Number and Runoff

Stage of Development: East Side Containment Berm with Swale
Drainage Area Description: POI-1 PRE

Soil Name and Hydrologic Group	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area (acres)	CN*Area
C	Impervious Area	98			1.13	111
C	Gravel	89			0.10	9
C	Grass - Good Condition	74			5.01	371
	Brush - Good Condition	70			4.13	289
						0
						0
						0
						0
						0
						0
				Totals	10.37	779

Use CN = 75

	Storm #1	Storm #2	Storm #3	Storm #4	Storm #5
Frequency (years)	2	5	10	25	100
24 Hour Rainfall, P (in)	3.8	5.25	6	7	9
Runoff, Q (in) (use P and CN with Table 2-1, Fig. 2-1, or Eqn. 2-3 and 2-4)	1.49	2.67	3.30	4.17	5.97

EA Engineering, Science, and Technology	Project:	AWI RD Phase II - Final
	Project #:	14530.11
	Task:	A; 211.41
	Calculated: JLL	Date: 1/4/2011
	Checked:	Date:

TR-55 Worksheet #3: Time of Concentration (T_c) or Travel Time (T_t)

Sheet Flow	Segment	AB				
1 Surface Description (Table 3-1)		Short Grass				
2 Manning's Roughness Coeff., n (Table 3-1)		0.15				
3 Flow Length, L (total L <= 100 ft)	ft	100				
4 Two year 24 hour Rainfall, P2	in	3.8				
5 Land Slope, s	ft/ft	0.012				
6 Tt	hr	0.184	0.000	0.000	0.000	0.184
Shallow Concentrated Flow	Segment	BC				
7 Surface Description (1=paved, 2=unpaved)		2				
8 Flow Length, L	ft	333				
9 Watercourse Slope, s	ft/ft	0.014				
10 Average Velocity, V (Fig. 3-1)	ft/s	1.94				
11 Tt	hr	0.048				0.048
Channel Flow	Segment	CD				
Type of Channel (trapezoidal, pipe, or box)		Trapezoidal				
Width of trapezoidal channel/pipe/box	ft	5				
Height of pipe/box or side slopes of trapezoidal channel (?H:1V)	ft	1.5				
Flow Depth	ft	1				
12 Cross Sectional Flow Area, a	sq ft	6.50	0.00	0.00	0.00	
13 Wetted Perimeter, pw	ft	8.61	0.00	0.00	0.00	
14 Hydraulic Radius, r	ft	0.755	0.000	0.000	0.000	
15 Channel Slope, s	ft/ft	0.012				
Channel Cover Material		Dense Weeds				
16 Manning's Roughness Coeff., n		0.08				
17 V	ft/s	1.692	0.000	0.000	0.000	
18 Flow Length, L	ft	453				
19 T_t	hr	0.074	0.000	0.000	0.000	0.074
					T_c =	0.306

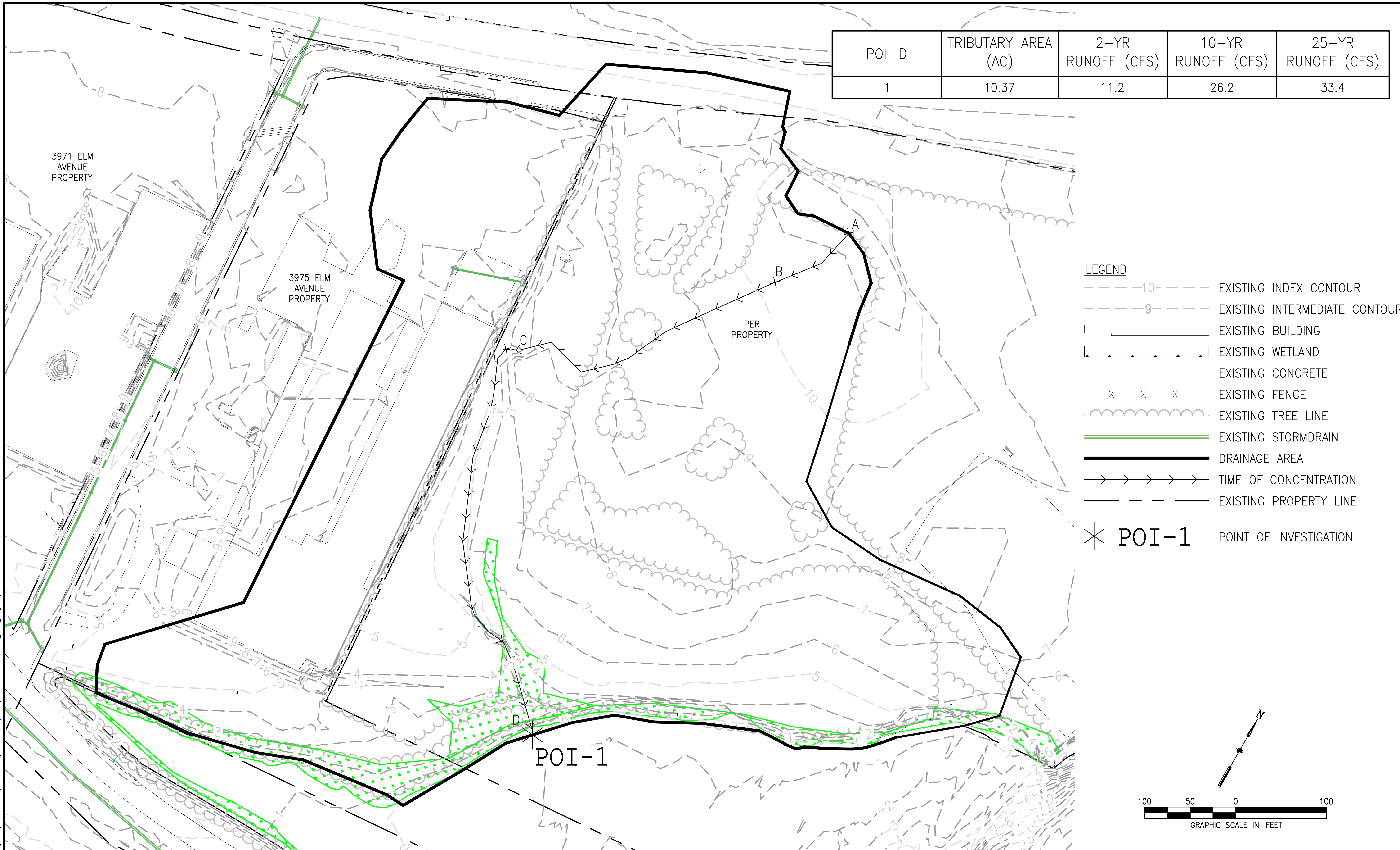
TR-55 Worksheet #4: Graphical Peak Discharge Method

1 Drainage Area, A_m	sq mi	0.016
Runoff Curve Number, CN (worksheet #2)		75
Time of Concentration, Tc (worksheet #3)	hr	0.306
Rainfall Distribution Type (I, IA, II, III)		III
Pond and Swamp Areas Spread Throughout Watershed	% Am	0.00

		Storm #1	Storm #2	Storm #3	Storm #4	Storm #5	Storm #6
2 Frequency	yr	2	5	10	25	100	
3 Rainfall, P (24 hour)[1]	in	3.8	5.3	6.0	7.0	9.0	
4 Initial Abstraction, I_a (Table 4-1)	in	0.667	0.667	0.667	0.667	0.667	
5 I_a/P		0.178	0.127	0.111	0.095	0.074	
6 Unit Peak Discharge, q_u (Exhibit 4)	csm/in	464.9	484.4	490.6	495.1	495.1	
7 Runoff, Q (worksheet 2)	in	1.49	2.67	3.30	4.17	5.97	
8 Pond & Swamp Adjustment Factor, F_p (F_p = 1.00 for none)		1.00	1.00	1.00	1.00	1.00	
9 Peak Discharge, q_p	cfs	11.2	20.9	26.2	33.4	47.9	

[1] - Per Virginia Stormwater Management Handbook First Edition, 1999

POI ID	TRIBUTARY AREA (AC)	2-YR RUNOFF (CFS)	10-YR RUNOFF (CFS)	25-YR RUNOFF (CFS)
1	10.37	11.2	26.2	33.4



FILE PATH: (LOVETON) L:\NON DOD\AWI CAD\PHASE 2\HYD\ESCB DRNG.DWG [PRE] 8/25/10

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

REMEDIAL DESIGN - PHASE 2
ATLANTIC WOOD INDUSTRIES SUPERFUND SITE
PORTSMOUTH, VIRGINIA

PRE-DEVELOPMENT DRAINAGE CONDITIONS

DESIGNED BY	DRAWN BY	DATE	PROJECT NO.
JLL	JLL	JAN 2011	14530.11
CHECKED BY	PROJECT MGR.	SCALE	FIGURE
GAT	PAP	1"=100'	1

Stormwater Management
Post-Development

EA Engineering, Science, and Technology

Project: AWI RD Phase II - Final
Project #: 14530.11
Task: A; 211.41
Calculated: JLL Date: 1/4/2011
Checked: Date:

TR-55 Worksheet #2: Runoff Curve Number and Runoff

Stage of Development: East Side Containment Berm with Swale
Drainage Area Description: POI-1a POST

Soil Name and Hydrologic Group	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Fig. 2-3	CN Fig. 2-4	Area (acres)	CN*Area
C	Impervious Area	98			1.13	111
C	Gravel	89			0.10	9
C	Grass - Good Condition	74			5.83	431
	Brush - Good Condition	70			2.50	175
						0
						0
						0
						0
						0
						0
				Totals	9.56	726

Use CN = 76

	Storm #1	Storm #2	Storm #3	Storm #4	Storm #5
Frequency (years)	2	5	10	25	100
24 Hour Rainfall, P (in)	3.8	5.25	6	7	9
Runoff, Q (in) (use P and CN with Table 2-1, Fig. 2-1, or Eqn. 2-3 and 2-4)	1.55	2.74	3.37	4.25	6.07

EA Engineering, Science, and Technology

Project:	AWI RD Phase II - Final		
Project #:	14530.11		
Task:	A; 211.41		
Calculated:	JLL	Date:	1/4/2011
Checked:		Date:	

TR-55 Worksheet #3: Time of Concentration (T_c) or Travel Time (T_t)

Sheet Flow	Segment	AB				
1 Surface Description (Table 3-1)		Short Grass				
2 Manning's Roughness Coeff., n (Table 3-1)		0.15				
3 Flow Length, L (total L <= 100 ft)	ft	100				
4 Two year 24 hour Rainfall, P2	in	3.8				
5 Land Slope, s	ft/ft	0.012				
6 Tt	hr	0.184	0.000	0.000	0.000	0.184
Shallow Concentrated Flow	**Segment**	**BC**				
7 Surface Description (1=paved, 2=unpaved)		2				
8 Flow Length, L	ft	333				
9 Watercourse Slope, s	ft/ft	0.014				
10 Average Velocity, V (Fig. 3-1)	ft/s	1.94				
11 Tt	hr	0.048				0.048
Channel Flow	**Segment**	**CD**	**DE**			
Type of Channel (trapezoidal, pipe, or box)		Trapezoidal	Trapezoidal			
Width of trapezoidal channel/pipe/box	ft	5	12			
Height of pipe/box or side slopes of trapezoidal channel (?H:1V)	ft	1.5	2			
Flow Depth	ft	1	1			
12 Cross Sectional Flow Area, a	sq ft	6.50	14.00	0.00	0.00	
13 Wetted Perimeter, pw	ft	8.61	16.47	0.00	0.00	
14 Hydraulic Radius, r	ft	0.755	0.850	0.000	0.000	
15 Channel Slope, s	ft/ft	0.007	0.005			
Channel Cover Material		Dense Weed	Short Grass			
16 Manning's Roughness Coeff., n		0.08	0.027			
17 V	ft/s	1.292	3.501	0.000	0.000	
18 Flow Length, L	ft	401	536			
19 T_t	hr	0.086	0.043	0.000	0.000	0.129
					T_c =	0.360

TR-55 Worksheet #4: Graphical Peak Discharge Method

1 Drainage Area, A_m	sq mi	0.015
Runoff Curve Number, CN (worksheet #2)		76
Time of Concentration, Tc (worksheet #3)	hr	0.360
Rainfall Distribution Type (I, IA, II, III)		III
Pond and Swamp Areas Spread Throughout Watershed	% Am	0.00

		Storm #1	Storm #2	Storm #3	Storm #4	Storm #5	Storm #6
2 Frequency	yr	2	5	10	25	100	
3 Rainfall, P (24 hour)[1]	in	3.8	5.3	6.0	7.0	9.0	
4 Initial Abstraction, I_a (Table 4-1)	in	0.632	0.632	0.632	0.632	0.632	
5 I_a/P		0.169	0.120	0.105	0.090	0.070	
6 Unit Peak Discharge, q_u (Exhibit 4)	csm/in	441.3	459.3	465.1	467.1	467.1	
7 Runoff, Q (worksheet 2)	in	1.55	2.74	3.37	4.25	6.07	
8 Pond & Swamp Adjustment Factor, F_p (F_p = 1.00 for none)		1.00	1.00	1.00	1.00	1.00	
9 Peak Discharge, q_p	cfs	10.2	18.8	23.4	29.7	42.4	

[1] - Per Virginia Stormwater Management Handbook First Edition, 1999

POI ID	TRIBUTARY AREA (AC)	2-YR RUNOFF (CFS)	10-YR RUNOFF (CFS)	25-YR RUNOFF (CFS)
1a	9.56	10.2	23.4	29.7

LEGEND

- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- EXISTING BUILDING
- EXISTING WETLAND
- EXISTING CONCRETE
- EXISTING FENCE
- EXISTING TREE LINE
- PROPOSED TREE LINE
- EXISTING STORMDRAIN
- DRAINAGE AREA
- TIME OF CONCENTRATION
- EXISTING PROPERTY LINE
- POI-1a POINT OF INVESTIGATION

100 50 0 100
GRAPHIC SCALE IN FEET

FILE PATH: (LOVETON) L:\NON DOD\AWI CAD\PHASE 2\HYD\ESCB DRNG.DWG [POST] 8/25/10

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

REMEDIAL DESIGN – PHASE 2
ATLANTIC WOOD INDUSTRIES SUPERFUND SITE
PORTSMOUTH, VIRGINIA

POST-DEVELOPMENT DRAINAGE CONDITIONS

DESIGNED BY	DRAWN BY	DATE	PROJECT NO.
JLL	JLL	JAN 2011	14530.11
CHECKED BY	PROJECT MGR.	SCALE	FIGURE
GAT	PAP	1"=100'	2

Ambient Air Standards Calculations

TABLE 1
AMBIENT AIR MONITORING LEVELS

CAS NO.	Contaminant (a)	RfC (mg/m^3)	IUR (µg/m^3)$^{-1}$	Carcinogenic Screening Level (µg/m^3)	Non-Carcinogenic Screening Level (µg/m^3)	Selected Monitoring Level (µg/m^3) (b)	"Not to Exceed" Offsite Monitoring Level (µg/m3) (c)
Volatiles							
71-43-2	Benzene	3.0E-02	7.8E-06	284	31	31	310
108-88-3	Toluene	5.0E+00	N/A	N/A	5,214	5,214	52,140
100-41-4	Ethylbenzene	1.0E+00	2.5E-06	885	1,043	885	8,850
1330-20-7	Xylenes	7.0E-01	N/A	N/A	730	730	7,300
Semivolatiles							
83-32-9	Acenapthene	N/A	N/A	N/A	N/A	N/A	N/A
120-12-7	Anthracene	N/A	N/A	N/A	N/A	N/A	N/A
56-66-3	Benz(a)anthracene	N/A	1.1E-04	2.0	N/A	2.0	20
50-32-8	Benzo(a)pyrene	N/A	1.1E-03	0.20	N/A	0.20	2
205-99-2	Benzo(b)fluoranthene	N/A	1.1E-04	2.0	N/A	2.0	20
207-08-9	Benzo(k)fluoranthene	N/A	1.1E-04	2.0	N/A	2.0	20
218-01-9	Chrysene	N/A	1.1E-05	20	N/A	20	200
53-70-3	Dibenz[a,h]anthracene	N/A	1.1E-03	0.20	N/A	0.20	2
206-44-0	Fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A
86-73-7	Fluorene	N/A	N/A	N/A	N/A	N/A	N/A
193-39-5	Indeno[1,2,3-cd]pyrene	N/A	1.1E-04	2.0	N/A	2.0	20
90-12-0	Methylnaphthalene, 1-	N/A	N/A	N/A	N/A	N/A	N/A
91-57-6	Methylnaphthalene, 2-	N/A	N/A	N/A	N/A	N/A	N/A
91-20-3	Napthalene	3.0E-03	3.4E-05	65	3	3	30
129-00-0	Pyrene	N/A	N/A	N/A	N/A	N/A	N/A
87-86-5	Pentachlorophenol	N/A	4.6E-06	481	N/A	481	4,810
Metals							
7440-38-2	Arsenic	1.5E-05	4.3E-03	0.5	0.02	0.02	0.2
7440-36-0	Antimony	N/A	N/A	N/A	N/A	N/A	N/A
7439-89-6	Iron	N/A	N/A	N/A	N/A	N/A	N/A
7440-28-0	Thallium	N/A	N/A	N/A	N/A	N/A	N/A

(a) Contaminants of concern (COCs) identified in the Record of Decision (EPA 2007)

(b) Minimum of the carcinogenic risk or non-carcinogenic effects values. The ambient air concentration a receptor can be exposed continuously throughout the project duration. Conservatively assumes a resident would be exposed at the fenceline of the project during the entire project duration.

(c) Level not to be exceeded off-site for any duration.
Note - Methodology and assumptions utilized to calculate monitoring levels is provided in the Basis of Design.

TABLE 2
CALCULATION OF AMBIENT AIR SCREENING LEVELS

Carcinogenic (Volatile Emmissions)

$$SLres\text{-}air\text{-}c\ (\mu g/m3) = \frac{TR \times ATr}{EFr \times EDr \times ETra \times (IUR^{-1})}$$

Non-Carcinogenic (Volatile Emmissions)

$$SLres\text{-}air\text{-}nc\ (\mu g/m3) = \frac{THQ \times ATr \times CF}{EFr \times EDr \times ETra \times (1/RfC)}$$

Where:

TR (Target Risk) (unitless) =	1.0E-05	(default)
THQ (Target Hazard Quotient) =	1.0	(default)
ATr (Averaging Time-carcinogen) (days) =	25,550	(=365 days/yr x 70 years; default)
ATr (Averaging Time-non carcinogen) (days) =	120	(=EDr*365 days/yr)
CF (Conversion Factor) =	1,000	(µg/mg)
EFr (Exposure Frequency) (days/yr) =	350	(default)
EDr (Exposure Duration) (yr) =	0.33	(site-specific), assumes construction will last 4 months
ETra (Exposure Time) (hr/hr) =	1	(default)
IUR (Inhalation Unit Risk) $(\mu g/m^3)^{-1}$=	chemical-specific	
RfC (Reference Concentration) (mg/m^3) =	chemical-specific	
LT (Lifetime) (yrs) =	70	(default)

	Contaminant	VOC	Mutagen	RfC (mg/m^3)	IUR $(\mu g/m^3)^{-1}$	Carcinogenic Screening Level $(\mu g/m^3)$	Non-Carcinogenic Screening Level $(\mu g/m^3)$
Volatiles							
	Benzene	V		3.0E-02	7.8E-06	2.8E+02	3.1E+01
	Toluene	V		5.0E+00	N/A	N/A	5.2E+03
	Ethylbenzene	V		1.0E+00	2.5E-06	8.8E+02	1.0E+03
	Xylenes	V		7.0E-01	N/A	N/A	7.3E+02
Semivolatiles							
	Acenapthene	V		N/A	N/A	N/A	N/A
	Anthracene	V		N/A	N/A	N/A	N/A
	Benz(a)anthracene		M	N/A	1.1E-04	2.0E+00	N/A
	Benzo(a)pyrene		M	N/A	1.1E-03	2.0E-01	N/A
	Benzo(b)fluoranthene		M	N/A	1.1E-04	2.0E+00	N/A
	Benzo(k)fluoranthene		M	N/A	1.1E-04	2.0E+00	N/A
	Chrysene		M	N/A	1.1E-05	2.0E+01	N/A
	Dibenz[a,h]anthracene		M	N/A	1.1E-03	2.0E-01	N/A
	Fluoranthene			N/A	N/A	N/A	N/A
	Fluorene	V		N/A	N/A	N/A	N/A
	Indeno[1,2,3-cd]pyrene		M	N/A	1.1E-04	2.0E+00	N/A
	Methylnaphthalene, 1-	V		N/A	N/A	N/A	N/A
	Methylnaphthalene, 2-	V		N/A	N/A	N/A	N/A
	Napthalene	V		3.0E-03	3.4E-05	6.5E+01	3.1E+00
	Pyrene	V		N/A	N/A	N/A	N/A
	Pentachlorophenol			N/A	4.6E-06	4.8E+02	N/A
Metals							
	Arsenic			1.5E-05	4.3E-03	5.1E-01	1.6E-02
	Antimony			N/A	N/A	N/A	N/A
	Iron			N/A	N/A	N/A	N/A
	Thallium			N/A	N/A	N/A	N/A

N/A = Not available.

Note:

For Mutagens, the IUR is modified by a 10-fold adjustment factor to account for the most susceptible receptor (0-2 years).

Appendix B

Geotechnical Investigation Report

GEOTECHNICAL INVESTIGATION REPORT

Atlantic Wood Industries Superfund Site – East Side Containment Berm
EA Engineering, Science and Technology
Portsmouth, Virginia

Schnabel Reference # 10233031
March 4, 2011

Schnabel
ENGINEERING

Schnabel
ENGINEERING

March 4, 2011

Mr. Brian McLaughlin
EA Engineering, Science and Technology, Inc
11019 McCormick Road
Hunt Valley, MD 21031

Subject: **Project 10233031, Geotechnical Investigation Report, Atlantic Wood Industries Superfund (AWI) Site, East Side Containment Berm, Portsmouth, Virginia**

Dear Brian,

SCHNABEL ENGINEERING, LLC (Schnabel), is pleased to submit our geotechnical investigation report for this project. This document includes attached figures and appendices with relevant data collected for this study. This study was performed in accordance with our revised proposal dated September 2, 2010, as authorized by EA Engineering, Science and Technology, Inc. (EA) Contract Modification 4 on November 18, 2010.

SCOPE

Our services include field engineering, subsurface exploration, soil laboratory testing, development of subsurface soil and groundwater profiles, and a geotechnical engineering evaluation of the proposed East Side Containment Berm. The objective of this study is to evaluate the subsurface conditions and perform a geotechnical engineering evaluation, including: slope stability, settlement and seepage analyses for the proposed East Side Containment Berm section provided by EA.

Services not described in our agreement are not included in this study. We would be happy to provide additional support services to the design team as the project demands.

SITE DESCRIPTION

The Atlantic Wood Industries (AWI) Superfund site is located in the City of Portsmouth, Virginia on the Southern Branch of the Elizabeth River – approximately 7 miles from the Chesapeake Bay. The land is surrounded by the Norfolk Naval Shipyard, the operations center for the Portsmouth Public Schools District (PPSD), PER Properties, and several other small industrial properties, including the Dixxon Company Property.

The proposed berm will bisect property owned by Dixxon and PER. This parcel of land is flanked by Veneer Road to the North and West, Elm Avenue (Virginia Route 337) to the South, and the Elizabeth

T/ 757-947-1220 F/ 757-947-1225
300 Ed Wright Lane, Suite I / Newport News, VA / 23606

River to the East. The topography is fairly flat with elevations varying from approximately El 5.0 to El 0 from West to East.

We obtained the site information from the topographic site plan dated July 2010, prepared by EA Engineering, and through our site visits.

PROPOSED CONSTRUCTION

The proposed East Side Containment Berm will be part of a containment cell for dredged sediments from the Elizabeth River. The Berm is proposed to extend from the northern end of the off shore sheet pile wall southwest along the north shore line of the inlet adjacent to the former Jordan Bridge to the approximate intersection of Elm Avenue and Verneer Road. The proposed crest length of the berm is approximately 1,000 ft and the proposed width of the berm is approximately 4.0 ft. The crest grade is planned at El 10.5 (NAVD 88). The berm is designed with slopes of 2H:1V. It is anticipated that the berm height will range from 4.0 to 9.0 ft above existing grades, with a variation in elevation along the alignment of the berm of about El 1 to El 6.

Approximately 1 to 2 years after berm construction, dredged sediments will be placed behind the berm and sheet pile containment wall. Water levels behind the berm may reach about El 10 (NAVD 88). In addition, a surcharge may be placed over the dredge material up to El 16.5 (NAVD 88) to expedite consolidation of the dredged material after the containment area is filled. Within the same time frame, controlled fill will be placed on the northern side of the berm up to the full height of the berm.

An approximately 12.0 ft wide open channel at the downstream toe of the proposed berm for controlling storm water has also been proposed. This open channel may require a geomembrane or clay liner in some areas to contain DNAPL – contaminated soil.

SUBSURFACE CONDITIONS

Geology

We reviewed boring logs, existing geologic data and information in our files to develop a geologic profile for this site. Based on this review, the site is generally underlain by recent alluvial soils overlying Pleistocene Age alluvial soils of the Norfolk Formation. These soils typically overlay alluvial soils of the Miocene Age Yorktown Formation. The Norfolk Formation is part of the Columbia Group; previous investigations have referred to these sediments as undifferentiated deposits of the Columbia Group. The Norfolk Formation typically consists of interlayered fine and coarse-grained soils. The fine-grained soils generally consist of clays and silts containing varying amounts of sand. These soils are generally normally consolidated to slightly preconsolidated. Poorly graded sands, silty sands, and clayey sands usually make up the coarse-grained soils. The coarse-grained soils may contain gravel.

Data Collection Techniques

We performed test borings and soil laboratory testing on samples collected to develop our geotechnical recommendations. Appendix A includes our summary of soil laboratory test results and laboratory test curves. Appendix B includes the logs from our subsurface exploration data, and a location plan.

Our geotechnical laboratory conducted tests on selected samples obtained in the borings. This testing aided in the classification of soils encountered in the subsurface exploration, and provided data for use in the development of foundation and earthwork recommendations. The logs in Appendix B show the natural moisture content values of selected soil samples. Appendix A presents the results of the remaining laboratory tests.

We observed Fishburne Drilling, Inc., of Chesapeake, Virginia drill six borings at this site. Two additional test borings, L-1 and L-4, were drilled on this site for Technical Memorandum No. 4, Task 8.3.4, dated March 2009. These boring logs have been included. Appendix B includes specific observations, remarks, logs for the borings, classification criteria and sampling protocols. Figure 1 shows the approximate boring locations. Elevations for borings ranged from about El 4 to El 6. We will retain soil samples up to 45 days beyond the issuance of this report, unless you request other disposition.

Generalized Subsurface Stratigraphy

We have characterized the following generalized subsurface soil stratigraphy based on the boring and data presented in Appendix B:

Stratum A: Existing Fill

Existing FILL soils, designated as Stratum A, were encountered in Borings B-1, B-2, B-3, B-6, and L-1. FILL soils consist of fine to coarse grained SILTY SAND (SM), containing concrete, brick and wood fragments, roots, gravel and crushed stone. These soils were encountered in the borings from below the surface layer to depths of 1.4 to 6.0 ft. Standard Penetration Test N-values ranged from 1 hammer blow for 18" of penetration (1/18") to 16, which correspond to very loose to medium dense soil.

Stratum B: Recent Alluvium

Below the fill soils of Stratum A, the borings encountered a stratum of recent alluvium. This stratum consisted of interlayered coarse- and fine-grained soils. The soils of Stratum B were encountered in all of the test borings, below the surface cover materials and the fill soils of Stratum A to depths of 4.0 ft to 14.5 ft.

Stratum B1: Coarse Grained Recent Alluvium

Stratum B1 consists of dark brown to brown to brown gray to gray, fine to medium grained SILTY SAND (SM), POORLY GRADED SAND w/ SILT (SP-SM) and POORLY GRADED SAND (SP), with varying amounts of shell fragments, organic matter, gravel, and lean and fat clay pockets. The coarse grained soils of Stratum B1 were encountered in all the test borings, except for Borings B-3 and L-1, to depths of 4.0 ft to 14.5 ft. The Standard Penetration Test (SPT) N-Values ranged from Weight of Hammer for 12" of penetration (WOH/12") to 13, corresponding to very loose to medium dense soil.

Stratum B2: Fine Grained Recent Alluvium

Stratum B2 consists of dark brown to brown to brown gray, very soft to medium stiff consistency LEAN CLAY (CL), and FAT CLAY W/ SAND (CH), with varying amounts of organic matter. These fine grained soils were encountered below Stratum A, where they were interbedded with the coarse grained soils of Stratum B1. These soils were encountered in Borings B-3, B-5, B-6, and L-1 to depths of 3.5 ft to 8.0 ft. Standard Penetration Test N-Values ranged from Weight of Hammer for 18" of penetration (WOH/18") to 10.

Soil laboratory testing performed on samples from Stratum B2 included a permeability test, consolidation test and a consolidated undrained (CU) triaxial test. The permeability, or hydraulic conductivity, was determined to be 2.7×10^{-6} cm/sec. The consolidation test indicated the soils tested were slightly preconsolidated to approximately 0.4 tsf in excess of the present overburden pressure. An effective angle of internal friction of 38 degrees and no cohesion was recorded for this stratum from the CU triaxial laboratory test results. The remaining test results are summarized in Appendix A and on the test boring logs in Appendix B.

Stratum C: Norfolk Formation

Below the Alluvial soils of Stratum B, the borings encountered the Pleistocene Age Norfolk Formation, designated as Stratum C. This stratum consisted of interlayered coarse- and fine-grained soils. These soils usually exhibit low to moderate strengths and compressibility and, are typically normally to slightly preconsolidated. The Stratum C soils were encountered in all the test borings to depths that ranged from 20.0 ft to 65.0 ft, coinciding with the maximum depths of soil sampling.

Stratum C1: Coarse Grained Norfolk Formation

Stratum C1 represents the coarse-grained soils of the Norfolk Formation. This stratum contains very loose to firm density POORLY GRADED SAND (SP), POORLY GRADED SAND w/SILT (SP-SM), SILTY SAND (SM), and CLAYEY SAND (SC). These soils were encountered below the soils of Stratum B in all of the borings, with the exception of Borings B-4 and B-5, to depths of 12.0 ft to 65.0 ft, with the later depth coinciding with the maximum depth of sampling. Standard Penetration Test N-Values ranged from Weight of Hammer for 18" of penetration (WOH/18") to 17. Organic matter was encountered in Borings B-1 and B-3.

Stratum C2: Fine Grained Norfolk Formation

Stratum C2 represents the fine-grained soils of the Norfolk Formation. This stratum consists of very soft to soft consistency LEAN CLAY w/SAND (CL), FAT CLAY (CH), and FAT CLAY w/SAND (CH). These soils were encountered in all the test borings below the soils of Stratum B1 and C1, to depths of 20.0 ft (the maximum depth of penetration in Borings B-2, B-3 and B-5) to 57.0 ft. SPT N-values ranged from Weight of Hammer for 24" of penetration (WOH/24") to 4.

A consolidation test was performed on a sample from Stratum B2. The consolidation test indicated the soils tested were slightly preconsolidated to approximately 1.2 tsf in excess of the present overburden pressure. The remaining test results are summarized in Appendix A and on the test boring logs in Appendix B.

Groundwater

The logs note groundwater level readings obtained in the borings during and after completion. We obtained groundwater level readings in open boreholes at depths of 1.6 to 4.0 ft. Our drilling subcontractor installed groundwater observation wells in Borings B-2, B-4 and B-6. We recorded groundwater levels in the wells at depths of 3.4 ft to 5.9 ft, about El 0.5 to -1.0, approximately 12 hours after completion of the drilling.

The groundwater levels on the logs show our estimate of the hydrostatic water table at the time of drilling. The final design should anticipate fluctuations in the hydrostatic water table depending on variations in precipitation, surface runoff, pumping, tidal action, river levels, evaporation, leaking utilities, and similar factors.

GEOTECHNICAL ANALYSIS

General

For our analysis, we modeled two representative sections of the dike. Both of these sections are based on a final topographic profile in a post-dredge placement scenario (placed to the top of dike at El 10.5 (NAVD 88), which also includes a surcharge placed up to El 16.5 (NAVD88). The sections incorporate a 12 ft wide open channel with an invert two feet below the existing ground surface elevation (GSE) at the outboard toe of the dike.

Based on our geotechnical investigation, representative Section 1 included two primary strata below the existing GSE:

> **Stratum 1:** Coarse grained soil consisting of Stratum A (Existing Fill), Stratum B1 (Coarse-Grained Recent Alluvium), and Stratum C1 (Corse-grained Norfolk Formation).
>
> **Stratum 2:** Fine-grained Norfolk Formation.

Representative Section 2 was identical to Section 1, with the exception of an interbedded fine-grained stratum (Stratum 1A) consisting of Stratum B2 (Fine-Grained Recent Alluvium) located within the coarse-grained Stratum 1. The plasticity, thickness, and location of this interbedded fine-grained layer were observed to vary, and was observed in about one-half of the exploration locations.

The existing GSE along the proposed dike alignment at the exploration locations varies from approximately EL 3 (NAVD 88) to EL 6 (NAVD 88). Both representative sections were based on constructing the dike at a representative existing GSE along the alignment at EL 3 (NAVD 88).

The models for Sections 1 and 2 were developed based on the soil strata encountered in the test borings, the material type anticipated to be used in the dike, and the anticipated material composition of the impounded sediment and surcharge. The engineering properties of each material type used in the model were characterized by laboratory data from our geotechnical exploration, correlations based on the material type/characteristics, and our experience, based on each condition analyzed. The engineering parameters developed for each material type were used for the geotechnical analyses presented herein.

Slope stability and seepage analysis were evaluated in general accordance with the methodology outlined in USACE Engineering Manuals EM 1110-2-1913 (Design and Construction of Levees), EM 1110-2-1902 (Slope Stability), and ETL 110-2-569 (Design Guidance for Levee Underseepage). Long-term settlement potential of the containment berm was evaluated using the US Army Corps of Engineers Computer Program CSETT, and based on the procedures described in EM 1110-1-1904 (Settlement Analysis).

Seepage Analysis

Seepage was modeled using GeoStudio's SEEP/W (v 7.17) computer program. SEEP/W is a two-dimensional finite element model used to model unconfined and confined seepage problems, including groundwater movement and pore water pressure distribution within porous materials such as soil and rock. SEEP/W can be used to model seepage conditions and evaluate various parameters, including hydraulic head/pore water pressure distribution, hydraulic gradient, volume of flow, and many others.

We evaluated the steady state seepage conditions by performing a transient analysis in which the initial water table was set at a depth 3 ft below the existing GSE (El 0.0 (NAVD88). This corresponds to the approximate representative depth of the ground water table observed in the test borings. A hydraulic boundary condition was then applied to the surface profile along the inboard dike face and along the top profile of the impounded sediments. The total hydraulic head for this boundary condition was set at three different ponded water table elevations: El 10.0, 8.5, and 7.0 (NAVD88). The decreasing values reflect how the ponder water table is expected to decrease over time, from a worst-case short term condition (highest elevation), to longer-term conditions where the ponded water elevation in the impounded sediment decreases as the sediment consolidates. A potential seepage face was applied to the outboard dike face and to the face of the channel extending from the outboard dike toe to the bottom of the channel. The transient analysis was carried out for a sufficient number of time steps until steady state conditions were achieved.

The steady state seepage condition was modeled using saturated hydraulic conductivities evaluated in laboratory testing from our geotechnical exploration, correlations based on the material type/characteristics, and our experience. The properties are summarized in the following table:

Table 1 – Soil types and engineering properties used for steady state seepage evaluation

Material Description	Classification	Saturated Hydraulic Conductivity, k_{sat} (ft/sec)
Dike/Berm	Clay (CH or CL)	8.9e-8
Sediment/Dredge	Organic Clay (OH) or Silt (OL)	3.3e-8
Surcharge	Silty Sand (SM)	8.2e-7
Stratum B2	Clay (CH or CL)	8.9e-8
Stratum A, B1, C1	Silty/Clayey Sand to Poorly Graded Sand (SM/SC, SP-SM, SP)	8.2e-7 (SM/SC) 3.3e-6 (SP or SP-SM)
Stratum C2	Clay (CH)	8.9e-8

The steady state seepage condition was modeled to establish the phreatic surface profile through the dike section. The final pore water pressure distribution associated with the steady state seepage condition was also used to evaluate global slope stability.

Global Stability Analysis

Slope stability calculations were performed for the two representative dike sections using GeoStudio's SLOPE/W (v. 7.17) computer program. We utilized this computer program to generate potential failure surfaces through likely entry and exit areas using Bishop, Ordinary, Janbu, and Morgenstern-Price stability methods. The entry and exit points were modified to search for both shallow sloughing and deep-seated failure surfaces. Non-circular failures were also analyzed, using the Slope/W optimization method. Soil parameters summarized in Table 2 below, were used for the strata in the representative dike sections based on an evaluation of our soil laboratory testing, field data and our experience.

Table 2 – Soil types and engineering properties used for stability analysis evaluation

Material Description	Classification	Type of Loading	Su (psf)	ϕ' (deg)	c' (psf)	γ_{moist} (pcf)
Dike/Berm	Clay (CH or CL)	drained	---	32	0	105
"	"	undrained	500	0	0	105
Sediment/Dredge	Organic Clay (OH) or Silt (OL)	drained	---	5	0	90
Surcharge	Silty Sand (SM)	drained	---			125
Stratum B2	Clay (CH or CL)	undrained	350	---	---	100
Stratum A, B1, C1	Silty Sand to Poorly Graded Sand (SM, SP-SM, SP)	drained	---	34	0	120
Stratum C2	Clay (CH)	undrained	350	---	---	100

Loading and engineering properties consider conditions immediately following placement of dredge and surcharge. The pore water pressure distribution considered in the global stability analysis corresponds to the steady state seepage conditions that were evaluated for the various impounded ground water elevations considered in the analyses.

The slope stability analysis considers the forces acting along many potential circular or "optimized" failure surfaces. For each potential failure surface, the driving forces that would cause the slope to slide and the forces resisting the sliding of the slope are calculated. A factor of safety against failure along the assumed circular or "optimized" failure surface is calculated by dividing the resisting forces by the driving forces. Therefore, a factor of safety of less than 1.0 would indicate that slope failure would likely occur. According to United States Army Corps of Engineers' (USACE) Engineering Manual (EM) 1110-2-1913, minimum factors of safety of 1.3 and 1.4 are required for the end-of-construction (short term) and long-term (steady state seepage) conditions, respectively.

Note that according to USACE Engineering Regulation (ER) 1110-2-1806 – Engineering and Design, Earthquake Design and Evaluation for Civil Works Projects – Section 9 (Embankment, Slopes and Soil Foundations) part (d) Evaluations, that "Evaluations of embankment, slope, and/or foundation susceptibility to liquefaction or excessive deformation will be performed for all projects located in seismic zones 3 and 4, and those projects in zone 2 where materials exist that are suspected to be susceptible to liquefaction or excessive deformation. Such evaluation and analysis should also be performed regardless of the seismic zone location of the project, where capable faults or recent earthquake epicenters are discovered within a distance that may result in damage to the structure". Since the site is located in Seismic Zone 1, no seismic evaluation is required.

Foundation Bearing Capacity Analysis

The net allowable bearing capacity was calculated for the ground surface profile on which the dike embankment and dredge material is to be placed. The net allowable bearing capacity was calculated from the ultimate bearing capacity using a factor of safety (FOS) of 3.0. This factor of safety represents an industry-standard Factor of Safety of 3.0 (USACE Engineering Manual, EM 1110-1-1905). The bearing pressure due to the placement of the dredge/surcharge and embankment was found to be less than the net allowable bearing capacity. Therefore, the minimum FOS for a foundation soil bearing capacity failure is acceptable.

Settlement Analysis

Settlement analysis was calculated manually for the coarse-grained strata as immediate settlement. Primary consolidation settlement of the underlying fine-grained soil was calculated using the US Army Corps of Engineers (USACE) computer program CSETT (version date 2002/02/28). CSETT is designed to compute induced stresses under general shaped loads and to calculate consolidation settlements in the underlying clay strata resulting from these stresses.

The following table summarizes the approximate ultimate settlement calculated at the following key locations along the proposed dike impoundment profile: (1) outboard dike toe; (2) dike centerline; (3) inboard dike toe; (4) at a location below the impoundment approximately 100 ft inboard of the inboard dike toe. For the purpose of the analysis, the settlement is calculated assuming the dike, impounded sediment, and surcharge are all constructed at time, t=0. These values indicate tolerable differential settlements across the dike profile. The calculated values are reasonable based on the subsurface conditions and loading and are not expected to adversely affect the short- or long-term stability of the dike.

Table 3 – Estimated settlement over time

Time Interval (yrs)	(1) Outboard Toe	(2) Centerline	(3) Inboard Toe	(4) 100' Inboard of Inboard Toe
Instantaneous elastic settlement (in.)	0.3	0.5	0.3	1.0
1 Year settlement (in.)	0.3	0.6	0.3	1.0
5 Year settlement (in.)	0.4	0.8	0.6	1.1
10 Year settlement (in.)	0.5	1.0	1.0	2.4
20 Year settlement (in.)	0.6	1.3	1.2	2.9
50 Year settlement (in.)	1.0	1.7	1.8	4.0
100 Year settlement (in.)	1.2	2.2	2.4	5.2
Ultimate	2.1	3.4	4.0	8.2

RESULTS

As previously mentioned, a sensitivity analysis was performed to evaluate the influence of the ponded water table within the impoundment. Also, both short-term (undrained) and long-term (drained) conditions for dike embankment loading were considered for the highest impoundment ground water elevation (El 10.0 NAVD88). The inboard and outboard dike slope faces were maintained at a 2:1 slope.

The calculated minimum global factors of safety for slope stability are summarized in Table 4. Plates showing the graphical output of the seepage and stability analyses are included in Appendix C.

Table 4 – Global stability minimum FOS summary

Configuration	Dike/Berm Embankment Loading	Impounded Ground Water Elevation (NAVD88)	Minimum FOS
Section 1	undrained	10	1.55
Section 1	drained	10	1.33
Section 1	drained	8.5	1.40
Section 1	drained	7	1.44
Section 2	undrained	10	1.53
Section 2	drained	10	1.28
Section 2	drained	8.5	1.38
Section 2	drained	7	1.42

Note that the short-term condition (ponded water table in the impoundment at El 10.0(NAVD88) was evaluated using the pore pressure distribution from the steady state seepage conditions. Therefore, the short-term factors of safety are fairly conservative, since the steady state condition is only fully developed when the wetting front has moved through the initially unsaturated dike/berm embankment.

RECOMMENDATIONS

The configuration shown for Sections 1 and 2 are acceptable for global stability based on the model and boundary conditions used in our analyses for undrained conditions at the highest impounded ground water elevation, and under drained conditions for impounded ground water elevations at approximately El 8.5 (NAVD88). The saturated hydraulic conductivity of the dike embankment used in the model was based on a value for similar soils (CH or CL) measured during our laboratory evaluation (2.7e-6 cm/sec or 8.9e-8 ft/sec). We recommend that a maximum saturated hydraulic conductivity for the dike embankment materials be equal to 1.0e-6 cm/sec based on our analysis.

CONSTRUCTION CONSIDERATIONS

Earthwork and Grading

The contractor should strip vegetation, topsoil, and organic matter from subgrades to receive compacted fill. The subsurface exploration indicated topsoil and rootmat to depths of 2 to 5 inches. Stripping of the topsoil and rootmat will result in some disturbance and contamination of near-surface soils, particularly during periods of wet weather. The test boring data indicates the approximate depth of topsoil based on our visual identification procedures. The depth of stripping necessary to provide a suitable base for placement and compaction of earthwork may include topsoil and other softer surficial layers with or without organic matter.

The near-surface granular layers were observed to consist of very loose and loose fill and recent alluvium. After stripping the topsoil and rootmat, we recommend stripping the upper 24 inches of fill and recent alluvium. The overexcavation should extend 5 feet beyond the limits of the dike embankment, but need not be considered in the prism occupied by the outboard drainage channel. The fill and recent alluvium can be then recompacted as described below for structural fill.

In isolated areas where overexcavation may potentially extend below the existing ground water table, rather than extend the excavation below the water table, the subgrade should be recompacted with a minimum of 5 overlapping passes of a minimum 20-ton smooth drum vibratory roller. The excavation should be extended to the approximate elevation of the water table, and then stabilized by compacting ballast stone into the subgrade. A non-woven geotextile should be placed over the ballast stone once a suitably stable subgrade is established based on the observation of the Geotechnical Engineer.

Before any fill placement, the Geotechnical Engineer should evaluate the soils for suitability based on observations of proofrolling with a loaded dump truck. The contractor should excavate areas exhibiting excessive pumping, weaving, or rutting, and replace these areas with additional compacted structural fill.

Compacted structural fill should consist of similar material to those that are included in this analysis. Soils used for dike embankment should consist of soils classified as CL or CH with a maximum saturated hydraulic conductivity of 1.0e-6 cm/sec. Highly plastic soils (CH) near the surface of the embankment should be chemically stabilized or protected with a sufficient layer of topsoil to avoid shrinkage and desiccation during dry weather, which may result in shallow slides after moisture gain during wet weather. The Geotechnical Engineer should evaluate all proposed fill materials prior to use to verify that it meets these material specifications.

Successful reuse of the excavated, on-site soils as compacted structural fill will depend on their natural moisture contents during excavation. The on-site soils are susceptible to moisture changes, will be easily disturbed, and will be difficult to compact under wet weather conditions. Drying of these soils will likely result in some delay, and may not be possible during late fall, winter and early spring.

Traffic on stripped or undercut subgrades should be limited to reduce disturbance of the underlying soils. Using lightweight, track-mounted dozer equipment for stripping will limit the disturbance of underlying soils, and may reduce the undercut volume needed. The contractor should provide site drainage to maintain subgrades free of water and to avoid saturation and disturbance of the subgrade soils before placing compacted fill. This will be important during all phases of the construction work. The contractor should be responsible for reworking of subgrades and compacted structural fill that were initially considered suitable but were later disturbed by equipment and/or weather.

Compacted structural fill should be placed in maximum eight-inch thick horizontal, loose lifts and should be compacted to at least 95 percent of maximum dry density per ASTM D 698, Standard Proctor. The contractor should bench compacted fill subgrades to allow placement of horizontal lifts.

Engineering Services During Construction

The engineering recommendations provided in this report are based on the information obtained from the subsurface exploration and laboratory testing. However, conditions on the site may vary between the discrete locations observed at the time of our subsurface exploration. The nature and extent of variations between borings may not become evident until during construction.

To account for this variability, we should provide professional observation and testing of actual subsurface conditions revealed during construction as an extension of our engineering services. These services will also help in evaluating the contractor's conformance with the plans and specifications. Because of our unique position to understand the intent of the geotechnical engineering recommendations, retaining Schnabel for these services will allow us to provide consistent service throughout the project construction.

General Specification Recommendations

An allowance should be established to account for possible additional costs that may be required to construct the berm. Additional costs may be incurred for a variety of reasons including variation of soil between borings, greater than anticipated unsuitable soils, need for borrow fill material, wet on-site soils, obstructions, temporary dewatering, etc.

We recommend that the construction contract include unit prices for scarifying and drying wet and/or loose subgrade soils, and provide an allowance for this work. In addition, the construction contract should include an allowance for undercutting soft or loose, near-surface soils, and replacement with compacted structural fill. Add/deduct unit prices should also be established in the contract so adjustments can be made for the actual volume of materials handled.

The project specifications should indicate the contractor's responsibility for providing adequate site drainage during construction. Inadequate drainage will most likely lead to disturbance of soils by construction traffic and increased volume of undercut.

This report may be made available to prospective bidders for informational purposes. We recommend that the project specifications contain the following statement:

> *Schnabel Engineering has prepared this geotechnical engineering report for this project. This report is for informational purposes only and is not part of the contract documents. The opinions expressed represent the Geotechnical Engineer's interpretation of the subsurface conditions, tests, and the results of analyses conducted. Should the data contained in this report not be adequate for the Contractor's purposes, the Contractor may make, before bidding, independent exploration, tests and analyses. This report may be examined by bidders at the office of the Owner, or copies may be obtained from the Owner at nominal charge.*

The contract documents should include the boring data provided in Appendix B.

Additional data and reports prepared by others that could have an impact upon the contractor's bid should also be made available to prospective bidders for informational purposes.

LIMITATIONS

We based the analyses and recommendations submitted in this report on the information revealed by our exploration. We attempted to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

We prepared this report to aid in the evaluation of this site and to assist in the design of the project. We intend it for use concerning this specific project. We based our recommendations on information on the site and proposed construction as described in this report. Substantial changes in the berm profile, location, or grade should be brought to our attention so we can modify our recommendations as needed. We would appreciate an opportunity to review the plans and specifications as they pertain to the recommendations contained in this report, and to submit our comments to you based on this review.

We have endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report, or any other instrument of service.

We appreciate the opportunity to be of service for this project. Please call us if you have any questions regarding this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

Frank J. Romano (dah)

Frank J. Romano
Senior Staff Engineer, EIT

Scott A. Raschke
Senior Associate, PE

Gilbert T. Seese
Principal, PE

COMMONWEALTH OF VIRGINIA
GILBERT T. SEESE, JR.
Lic. No. 012025
PROFESSIONAL ENGINEER

FJR:SAR:GTS:dah

Figures
Appendix A: Soil Laboratory Test Data
Appendix B: Subsurface Exploration Data
Appendix C: Geotechnical Analyses

Distribution:

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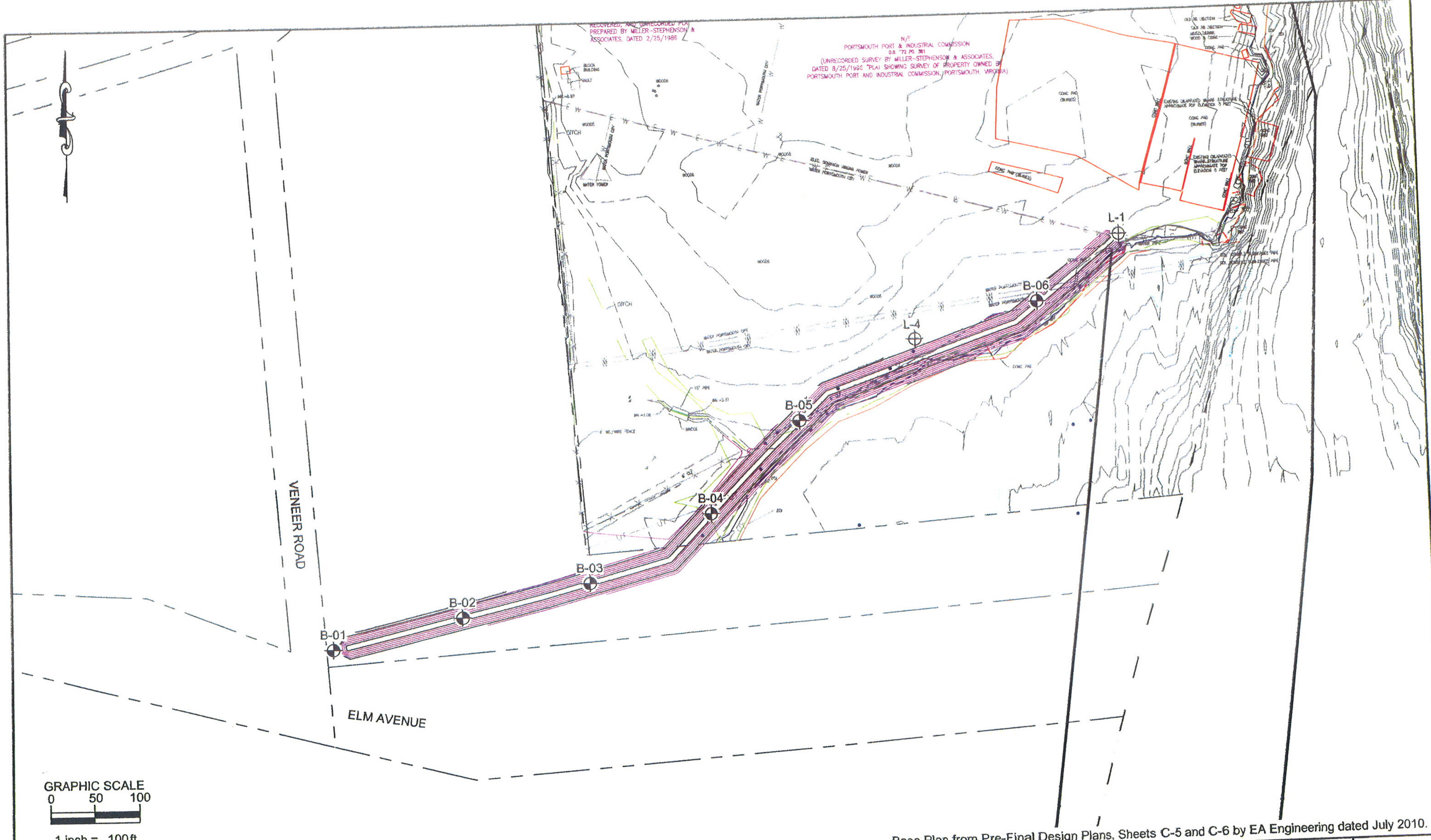
FIGURES

Test Boring Location Plan, Figure 1



LEGEND

- APPROXIMATE BORING LOCATION
- APPROXIMATE PREVIOUS BORING LOCATION

Base Plan from Pre-Final Design Plans, Sheets C-5 and C-6 by EA Engineering dated July 2010.

Schnabel ENGINEERING	EAST SIDE CONTAINMENT BERM ATLANTIC WOOD INDUSTRIES SUPERFUND SITE PORTSMOUTH, VIRGINIA	Figure Name: BORING LOCATION PLAN	Done: N. DUMAS	Figure Number: 1
		Project Number: 10233031	Reviewed: G. SEESE	Date: 02/2011

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APPENDIX A

SOIL LABORATORY TEST DATA

Summary of Soil Laboratory Tests (2 Sheets)
Gradation Curves (4 Sheets)
Permeability Test (1 Sheet)
Consolidation Test Curves (2 Sheets)
CU Triaxial Test Curves (1 Sheet)

Summary Of Laboratory Tests

Project Number: 10233031.00.01

Boring No.	Sample Depth ft / Elevation ft	Sample Type	Description of Soil Specimen	Wet Natural Density (pcf)	Natural Moisture (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	% Passing No. 40 Sieve	% Passing No. 10 Sieve	% Retained No. 4 Sieve	Specific Gravity
B-5A	1.5 - 3.5 2.5 - 0.5	Tube	LEAN CLAY WITH SAND (CL) - light gray	128.7	26.3	42	16	26	73.2	97.5	100.0	0.0	2.70
B-6	20.0 - 22.0 -15.0 - -17.0	Tube	FAT CLAY (CH) - gray	94.6	79.8	64	28	36	98.7	–	–	–	2.71
B-6A	4.0 - 6.0 1.0 - -1.0	Tube	SILTY SAND (SM), fine to medium - light gray	126.9	19.1	NP	NP	NP	15.7	95.5	100.0	0.0	2.68

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; – indicates no test performed

Schnabel ENGINEERING

Project: East Side Berm, AWI Site
Elm Avenue and Veneer Road
Portsmouth, VA

Project Number 10233031.00.01

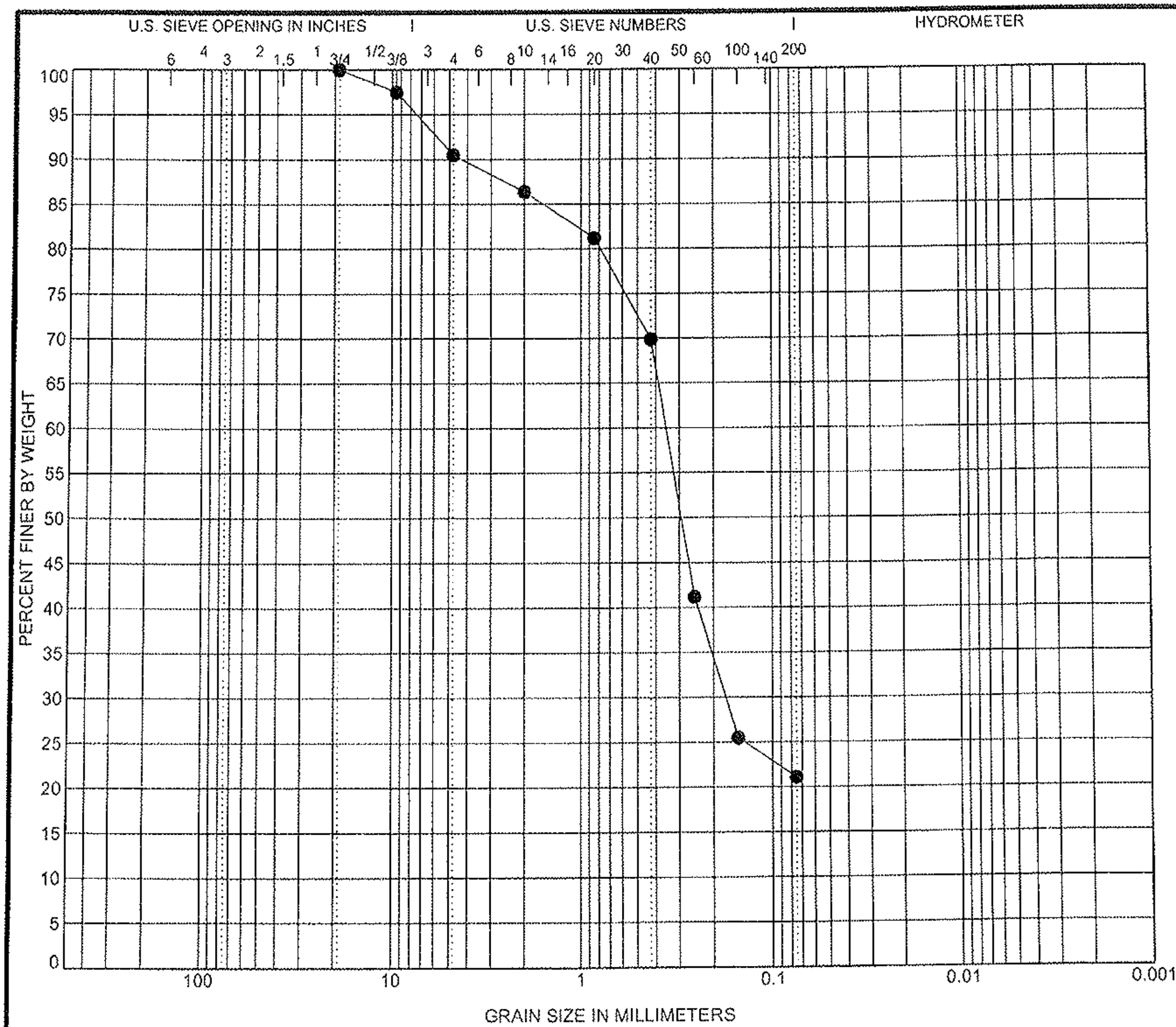
Summary Of Laboratory Tests

Boring No.	Sample Depth ft / Elevation ft	Sample Type	Description of Soil Specimen	Natural Moisture (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 40 Sieve	% Passing No. 200 Sieve
B-1	2.0 - 4.0 3.0 - 1.0	Jar	SILTY, CLAYEY SAND (SC-SM), fine to coarse grained, gray-brown and dark gray (VISUAL)	20.5	--	--	--	69.9	21.1
B-4	2.0 - 4.0 1.0 - -1.0	Jar	SILTY SAND (SM), fine to medium grained, light gray	19.1	NP	NP	NP	95.1	13.8
B-6	4.0 - 6.0 1.0 - -1.0	Jar	SILTY, CLAYEY SAND (SC-SM), fine to coarse grained, brown	20.1	21	15	6	91.0	25.3

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

Project: East Side Berm, AWI Site
Elm Avenue and Veneer Road
Portsmouth, VA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen		Sample Description	LL	PL	PI		
●	B-1	2.0 ft	**SILTY, CLAYEY SAND (SC-SM), fine to coarse grained, gray-brown and dark gray (VISUAL)**	--	--	--		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**19**	**0.354**	**0.174**		**9.5**	**69.4**	**21.1**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8"	3/4"
% Finer	21.1	25.5	41.2	69.9	81.2	86.4	90.5	97.5	100.0

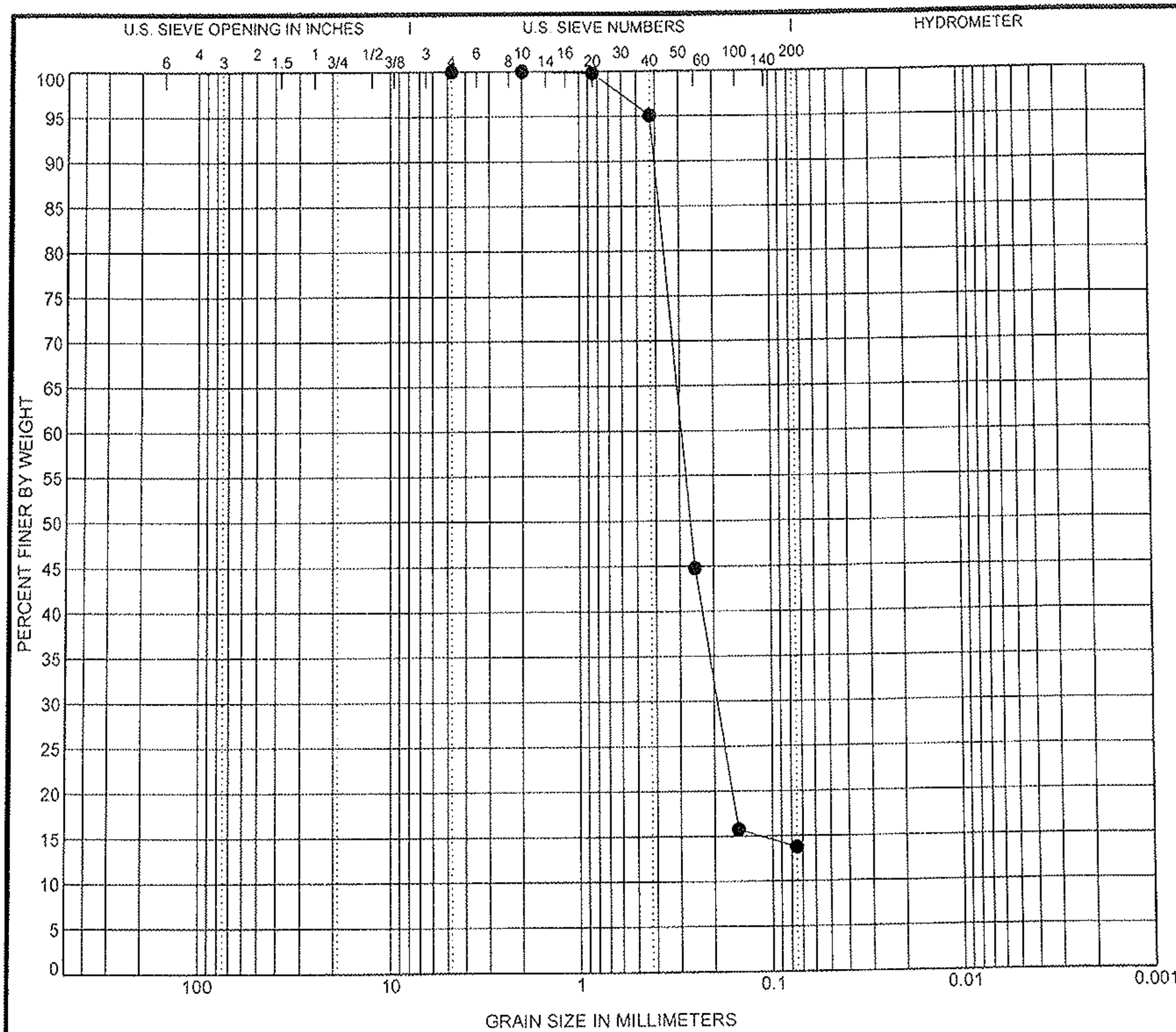
Tested By	Tested Date	Reviewed By	Calc By
DL	1/10/11		

Schnabel ENGINEERING

GRADATION CURVE

Project: East Side Berm, AWI Site
Elm Avenue and Veneer Road
Portsmouth, VA

Contract: 10233031



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● B-4	2.0 ft	SILTY SAND (SM), fine to medium grained, light gray	NP	NP	NP		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	4.75	0.293	0.193		0.0	86.2	13.8	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4
% Finer	13.8	15.8	44.8	95.1	99.8	100.0	100.0

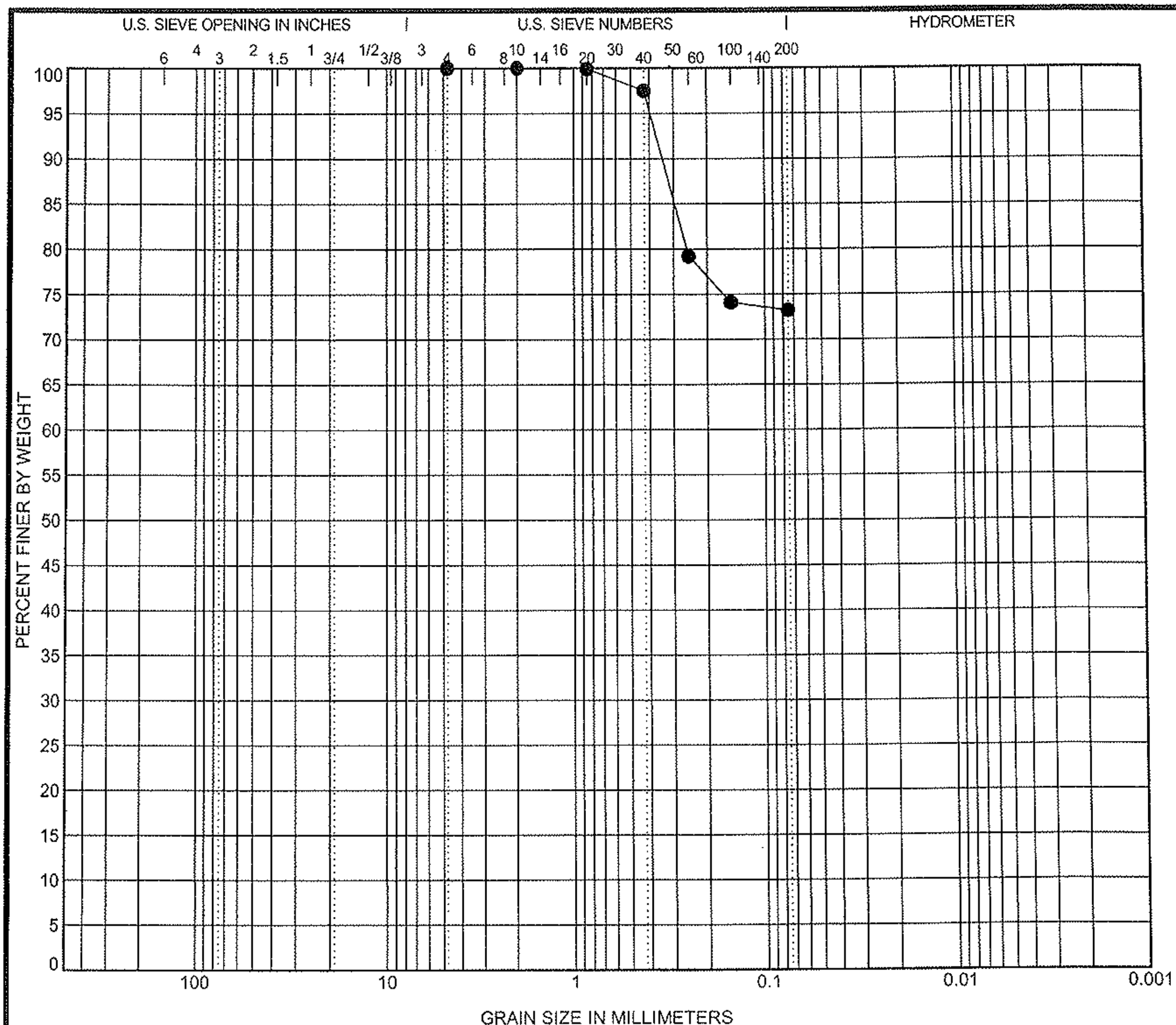
Tested By	Tested Date	Reviewed By	Calc By
DL	1/10/11		

Schnabel ENGINEERING

GRADATION CURVE

Project: East Side Berm, AWI Site
Elm Avenue and Veneer Road
Portsmouth, VA

Contract: 10233031



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen		Sample Description	LL	PL	PI
●	B-5A	1.5 ft	**LEAN CLAY WITH SAND (CL) - light gray**	**42**	**16**	**26**

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**4.75**				**0.0**	**26.8**	**73.2**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4
% Finer	73.2	74.1	79.2	97.5	99.9	100.0	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	12/7/10	TTM	MJF

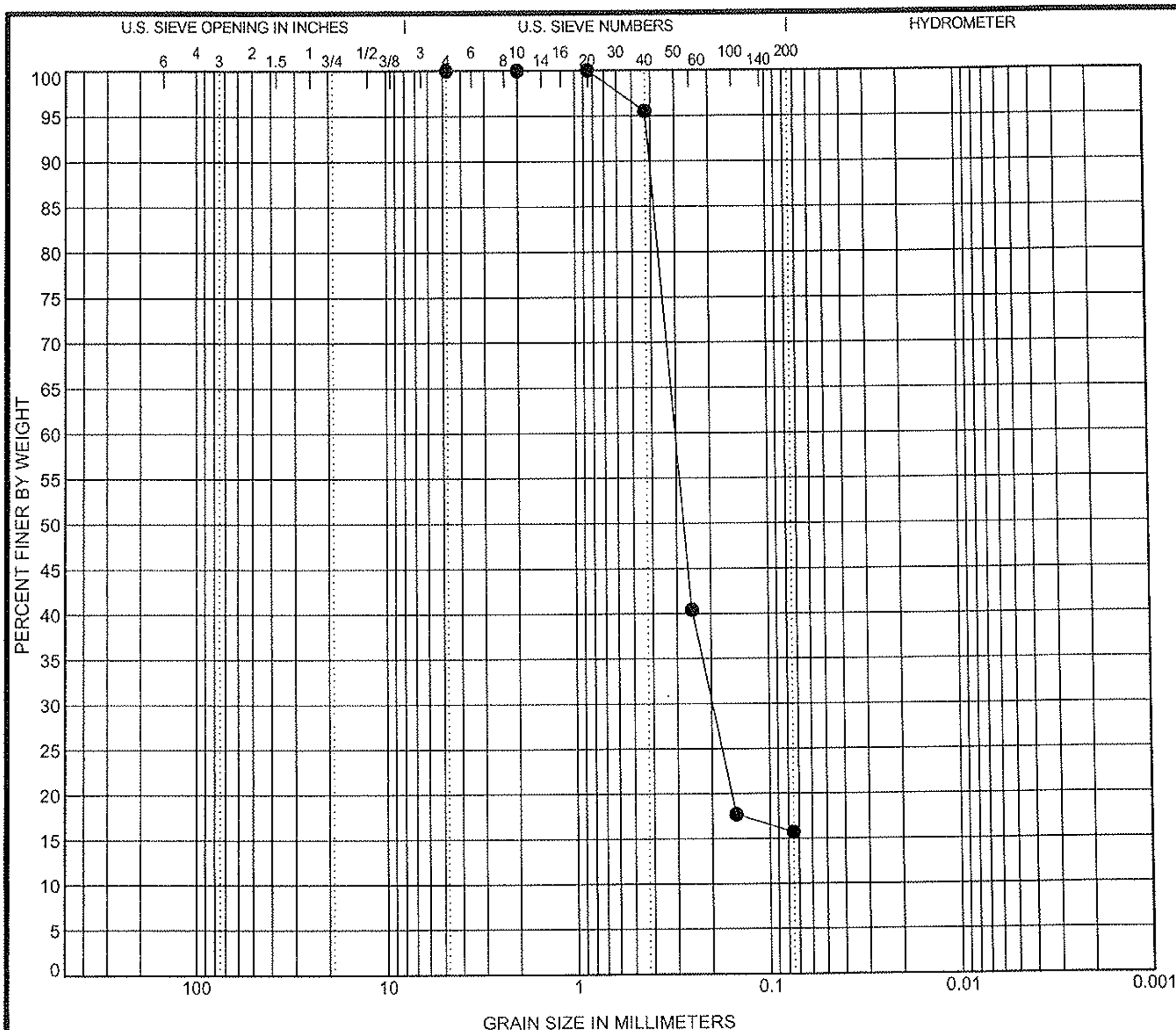
Schnabel
ENGINEERING

GRADATION CURVE

Project: East Side Berm
AWI Site
Portsmouth, VA

Contract: 10233031.00.01

SIEVE 1/SHEET 10233031.00.01.GPJ SCHNABEL DATA TEMPLATE 2008_04_22.GDT 12/21/10



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<tr><td rowspan="2">COBBLES</td><td colspan="2">GRAVEL</td><td colspan="3">SAND</td><td rowspan="2">SILT OR CLAY</td></tr>
<tr><td>coarse</td><td>fine</td><td>coarse</td><td>medium</td><td>fine</td></tr>
</table>

Specimen		Sample Description	LL	PL	PI
● B-6A	4.0 ft	SILTY SAND (SM), fine to medium - light gray	NP	NP	NP

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**4.75**	**0.302**	**0.198**		**0.0**	**84.3**	**15.7**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4
% Finer	15.7	17.7	40.4	95.5	100.0	100.0	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	12/6/10		MJF

Schnabel ENGINEERING

GRADATION CURVE

Project: East Side Berm
AWI Site
Portsmouth, VA

Contract: 10233031.00.01

Hydraulic Conductivity Determination

Schnabel ENGINEERING

Using Flexible Wall Permeameter (ASTM D5084) 12/22/2010

Project:	East Side Berm	Schnabel No.:	10233031.00.01
	AWI Site	Boring No.:	B-5A
Location:	Portsmouth, VA	Depth:	1.5-3.5 ft.

Specimen Data

Specimen Type:	Tube Sample	Cell Press., psi:	27.0
Consol. Stress (psi):	3.0	Back Press., psi:	24.0
Soil Description:	LEAN CLAY WITH SAND (CL) - light gray	Specific Gravity:	2.70
Remarks:			

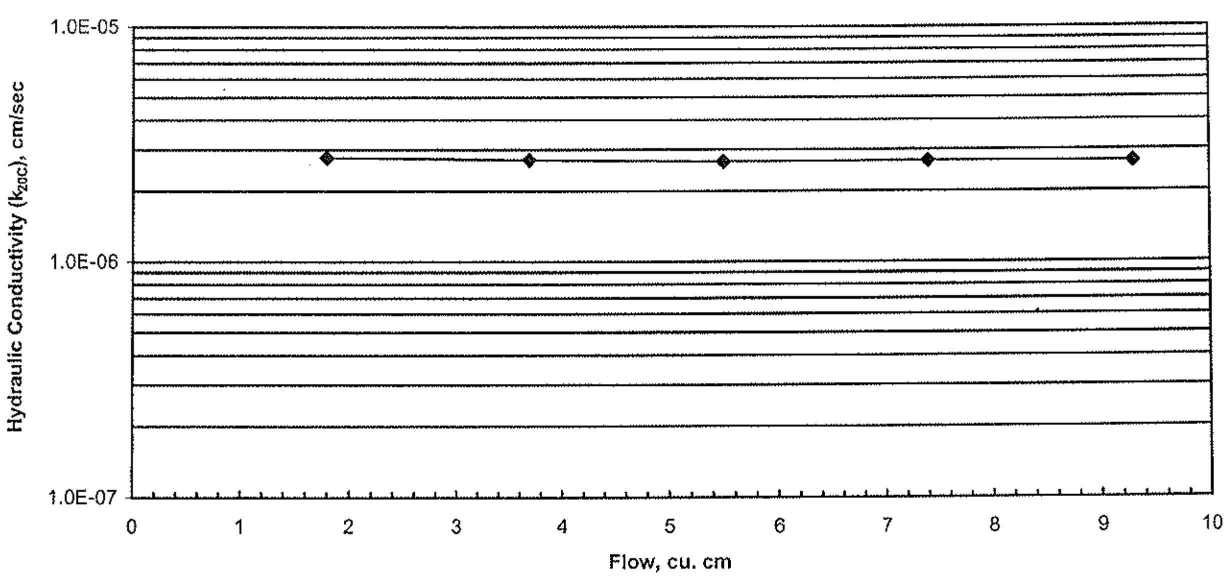
	Initial	Final
Height (in.):	1.30	1.30
Diameter (in.):	2.867	2.86
Volume (in^3):	8.40	8.33
Volume (cm^3):	137.7	136.5
Moist Unit Weight (pcf):	124.5	125.1
Moisture Content (%):	25.5	25.0
Dry Unit Weight (pcf):	99.2	100.1
Saturation:	99	99
Void Ratio:	0.70	0.68

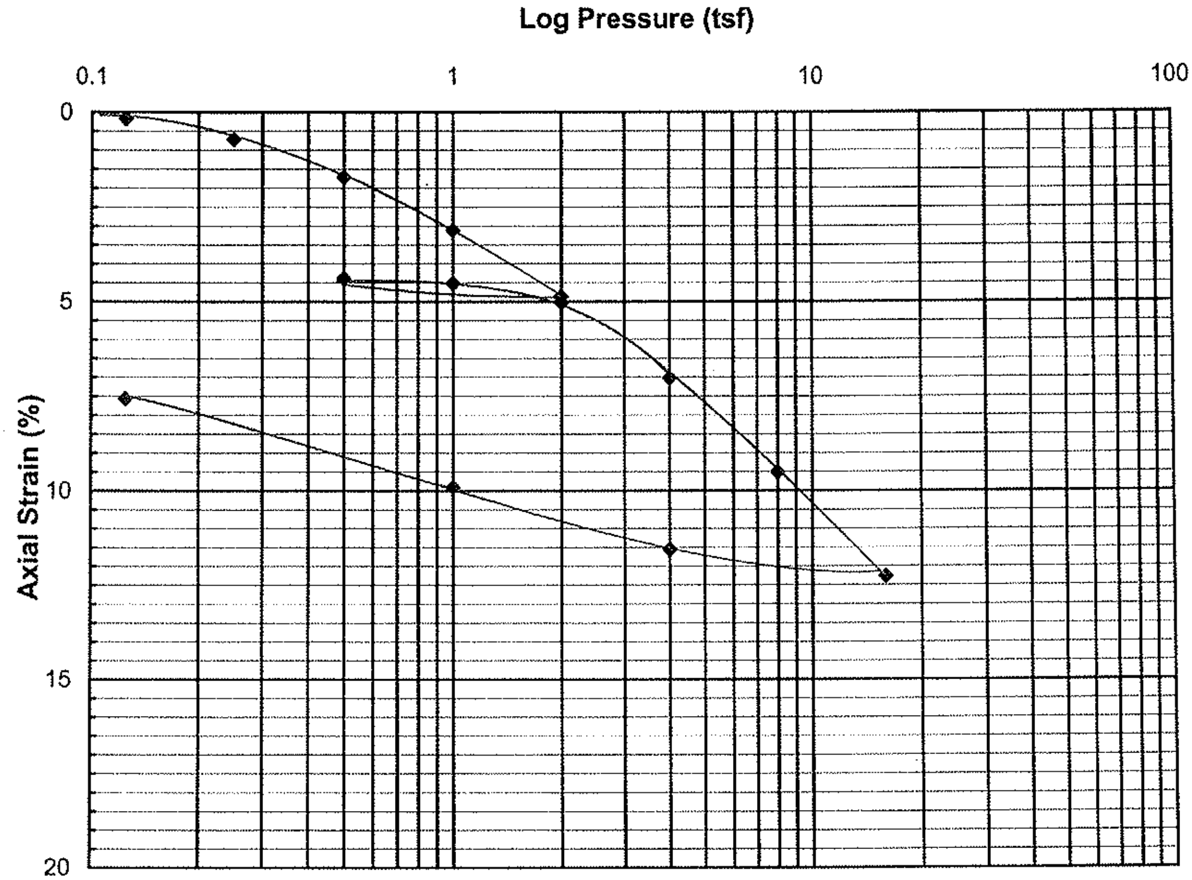
Liquid Limit (LL):	42
Plasticity Index (PI):	26
% < No. 200 Sieve:	73.2

Test Data

Permeant:	De-Aired Water
Hydraulic Gradient:	5
Hydraulic Conductivity (k_{20C}), cm/sec:	2.7E-06

Hydraulic Conductivity vs. Flow





Probable Preconsolidation Pressure (Pp), tsf:	*0.6*	**Recompression Ratio (Cer):**	*0.009*
Type of Specimen:	*Tube Sample*	**Compression Ratio (Cec):**	*0.100*

Description: *LEAN CLAY WITH SAND (CL) - light gray*

LL:	*42*	**PI:**	*26*	**Gs:**	*2.70*	**P_o' (tsf):**	*0.19*
% < No. 200:	*73.2*	**Test Method:**	*ASTM D2435 Method A*				

Test Condition: *Inundated @ 0.05 tsf*

	Initial	Final
Water Content, %	*24.0*	*19.9*
Void Ratio	*0.65*	*0.52*
Saturation, %	*100*	*100*
Dry Unit Weight, pcf	*102.3*	*110.7*

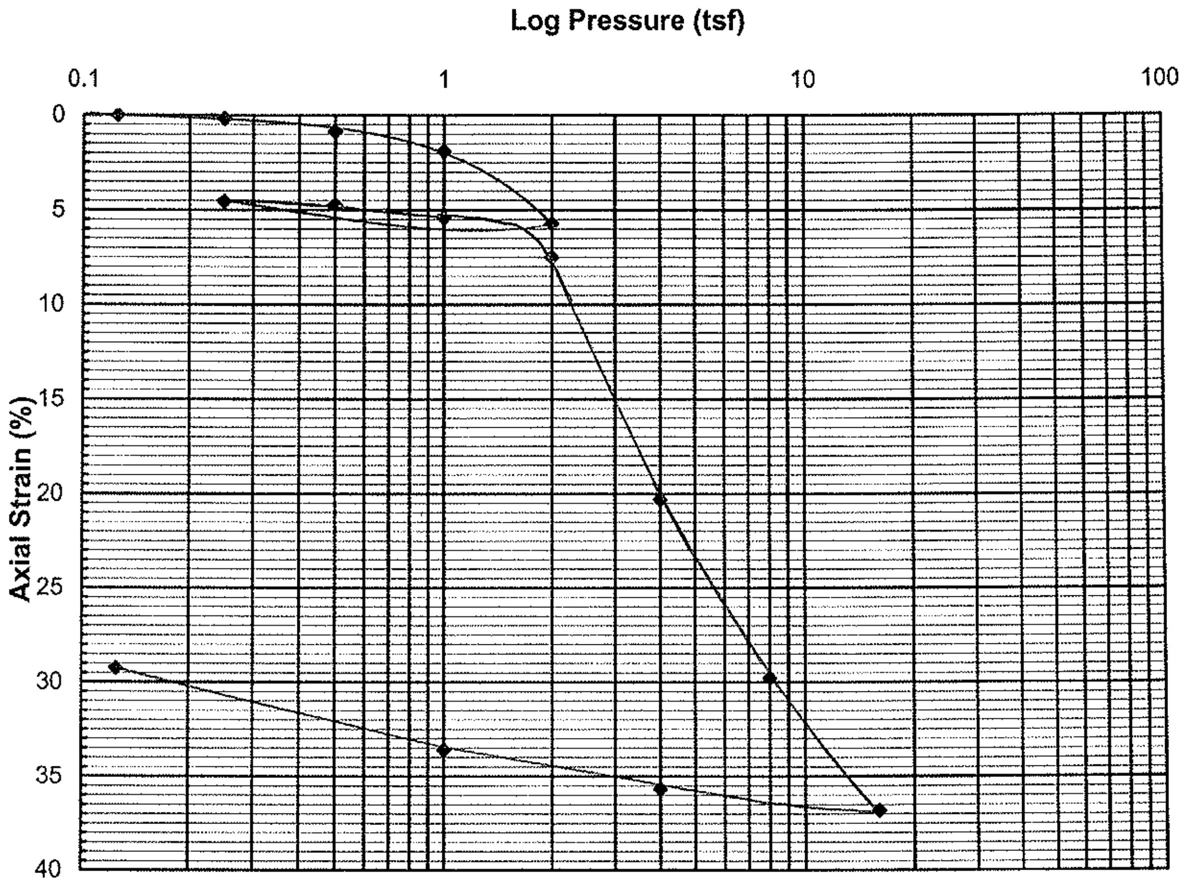
Remarks:

Average Water Content of Trimmings, %: *23.8*

Schnabel ENGINEERING

Project:	East Side Berm AWI Site		
Location	*Porstmouth, VA*		
Boring:	*B-5A*	**Schnabel No.:**	*10233031.00.01*
Depth:	*1.5-3.5 ft.*	**Elevation:**	*2.5 to 0.5 ft.*
Date:	*1/17/2011*	**Reviewed by:**	*CJS*

Consolidation Test Report



Probable Preconsolidation Pressure (Pp), tsf:	1.8	Recompression Ratio (Cer):	0.030
Type of Specimen:	Tube Sample	Compression Ratio (Cec):	0.330

Description: FAT CLAY (CH) - gray		Initial	Final
	Water Content, %	77.3	44.9
LL: 64 · PI: 36 · Gs: 2.71 · P_o' (tsf): 0.64	Void Ratio	2.10	1.20
% < No. 200: 98.7 · Test Method: ASTM D2435 Method A	Saturation, %	100	100
Test Condition: Inundated @ 0.05 tsf	Dry Unit Weight, pcf	54.5	77.0

Remarks:

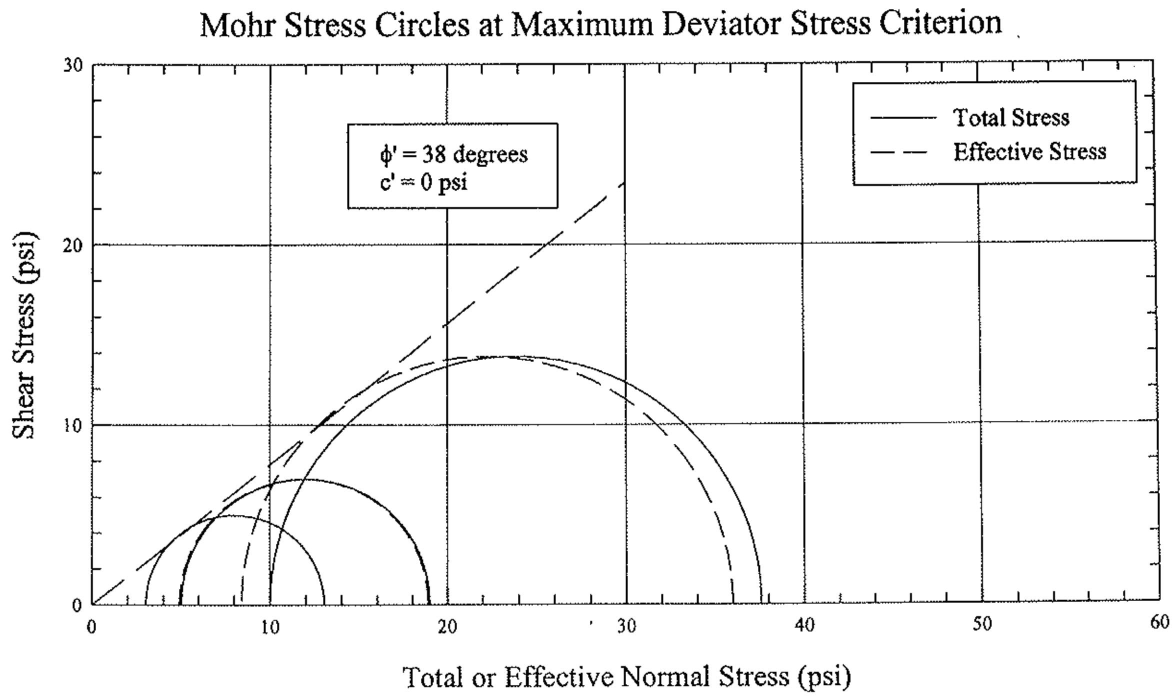
Average Water Content of Trimmings, %: 77.8

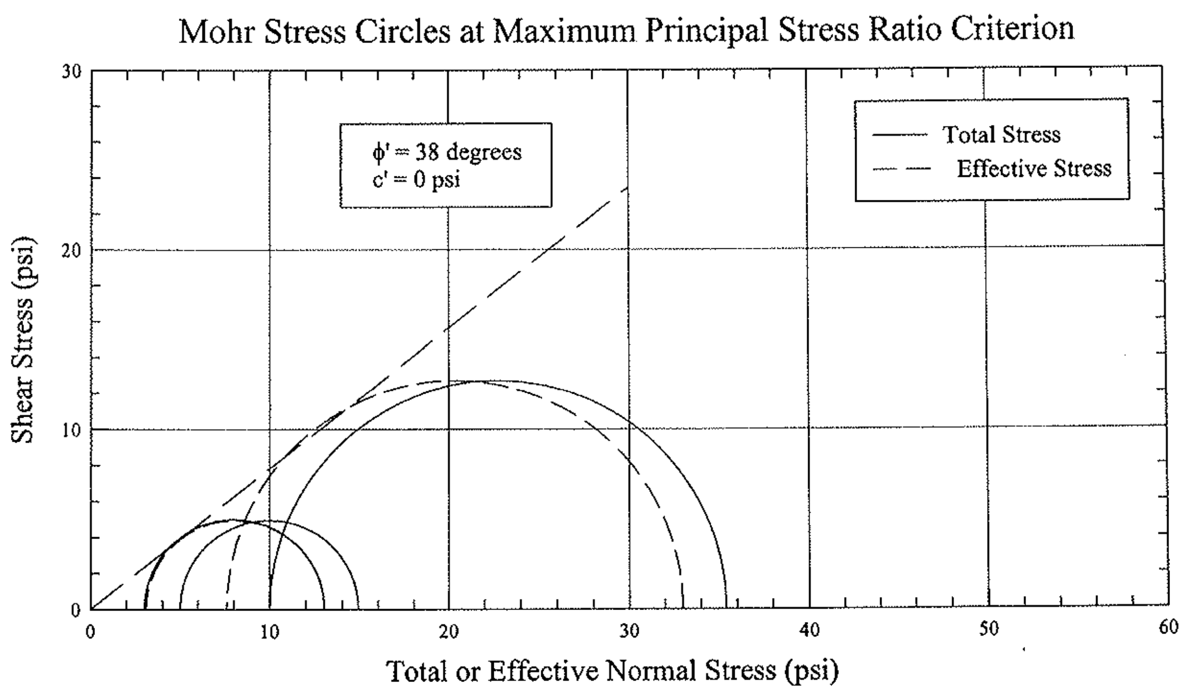
Schnabel ENGINEERING

Project:	East Side Berm AWI Site
Location	Portsmouth, VA
Boring: B-6	**Schnabel No.:** 10233031.00.01
Depth: 20-22 ft.	**Elevation:** -15 to -17 ft.
Date: 1/17/2011	**Reviewed by:** CJS

Consolidation Test Report

Consolidated Undrained (CU) Triaxial Shear (ASTM D4767)





Boring No.: *B-6A / B-5A* Depth: *4-6 / 1.5-3.5 ft* SE Contract: *1022031.00.01* Date: *1/17/2011*

Sample Description: *SILTY SAND (SM), f - m - light gray / LEAN CLAY WITH SAND (CL) - light gray* Reviewed By: *CJS*

Specimen Type: *Tube Sample* Gs: *2.68 / 2.70* LL: *NP / 42* PI: *NP / 26* %<200: *15.7 / 73.2*

Schnabel ENGINEERING

East Side Berm
AWI Site

APPENDIX B

SUBSURFACE EXPLORATION DATA

SUBSURFACE INVESTIGATION PROCEDURES

Boring Procedures

Drillers advanced the borings using mud rotary drilling. With mud rotary drilling techniques, driller's mud is used to maintain an open bore hole. The hole is advanced by using a nominal 3-inch O.D. tri-cone roller bit. At the designated depth, drillers remove the roller bit and perform the Standard Penetration Test. Water level data indicated on the logs may not be indicative of actual groundwater levels because of the presence of drilling fluid in the borehole. The logs indicate water level data.

Standard Penetration Test Results

The numbers in the Sampling Data column of the boring logs represent Standard Penetration Test (SPT) results. Each number represents the blows needed to drive a two-inch O.D., 1⅜ inch I.D. split-spoon sampler six inches, using a 140-pound hammer falling 30 inches. The sampler is typically driven a total of 18 or 24 inches. The first six inch interval usually represents a seating interval. The total of the number of blows for the second and third six-inch intervals is the SPT "N value." When the blow count reaches 100 before the full driving distance, we determine the SPT N value based on extrapolation of the blows recorded. The SPT is conducted according to ASTM D 1586.

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D 2487) based on visual observation and limited laboratory testing of the samples. Criteria for visual identification of soil samples are included in this appendix. Some variation may be expected between samples visually classified and samples classified in the laboratory.

Pocket Penetrometer Results

The values following "PP= " in the Sampling Data column of the logs represent pocket penetrometer readings. Pocket penetrometer readings provide an estimate of the unconfined compressive strength of fine-grained soils.

Water Observation Wells

Our drilling subcontractor installed temporary water observation wells in Borings B-2, B-4 and B-6 by inserting a hand-slotted, 1¼-inch PVC pipe in each of these borings. Each pipe was capped, and the area surrounding the pipe was backfilled with cuttings from the boring. The pipes were later removed and the holes backfilled with grout.

Boring Locations and Elevations

Our personnel staked the borings by using GPS locating equipment. Elevations were estimated based on ground elevations derived from the site plan provided by EA Engineering, Science and Technology. Figure 1 shows the approximate boring locations. Project planning should consider these locations and elevations no more accurate than the methods and plans used to obtain them.

TEST BORING LOG GENERAL NOTES

1. Numbers in the sampling data column indicate the number of blows required to drive a 2-inch O.D., 1 3/8-inch I.D. split spoon sampler through three 6-inch intervals, or as indicated, using a 140-pound hammer falling 30 inches, according to ASTM D-1586. The sum of the second and third 6-inch blow count intervals is the N value of the Standard Penetration Test (SPT).

2. Strata descriptions are based on visual inspection and are in accordance with the Unified Soil Classification System, ASTM D-2488.

3. Refusal at the surface of rock, boulder, or obstruction is defined as a penetration resistance of 100 blows for 2 inches penetration or less.

4. Disintegrated rock is defined as residual earth material with a penetration resistance between 60 blows per foot and refusal.

5. Key to abbreviations and symbols:

w %	= Moisture Content	3T	= 3 inch Tube Sample
☒	Area Sampled	24/20	= Tube Sample Pushed 24 inches, 20 inches Recovered
◸	= Rock Coring	REC	= Rock Core Recovery
WOR	= Weight of Rod	RQD	= Rock Quality Designation
WOH	= Weight of Hammer	WOW	= Water Observation Well

6. The boring logs and related information depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions at the boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at the boring locations.

7. The stratification lines represent the approximate boundary between soils and/or rock types as estimated in the drilling and sampling operation. Some variation may be expected vertically between samples taken. The soil profile, water level observations, and penetration resistances presented on the boring logs have been made with reasonable care and accuracy, but must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.

8. Estimated ground water levels are indicated on the logs. These are only estimates from available data and may vary with variations in environmental conditions, precipitation, surface drainage, time of the year, evaporation, adjacent construction, porosity of the soil, site topography and other similar factors.

IDENTIFICATION OF SOIL

I. DEFINITION OF SOIL GROUP NAMES   ASTM D2487

			Symbol	Group Name
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels - More than 50% of coarse fraction retained on No. 4 sieve Coarse, ¾ to 3" Fine, No. 4 to ¾"	Clean Gravels Less than 5% fines	GW	Well graded gravel
			GP	Poorly graded gravel
		Gravels with Fines More than 12% fines	GM	Silty gravel
			GC	Clayey gravel
	Sands - 50% or more of coarse fraction passes No. 4 sieve Coarse, No. 10 to No. 4 Medium, No. 40 to No. 10 Fine, No. 200 to No. 40	Clean Sands Less than 5% fines	SW	Well graded sand
			SP	Poorly graded sand
		Sands with Fines More than 12% fines	SM	Silty sand
			SC	Clayey sand
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays - Liquid Limit less than 50 Low to medium plasticity	Inorganic	CL	Lean clay
			ML	Silt
		Organic	OL	Organic clay
				Organic silt
	Silts and Clays - Liquid Limit 50 or more Medium to high plasticity	Inorganic	CH	Fat clay
			MH	Elastic silt
		Organic	OH	Organic clay
				Organic silt
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor		PT	Peat

II. DEFINITION OF MINOR COMPONENT PROPORTIONS

Minor Component	Approximate Percentage of Fraction by Weight
Adjective Form	
Gravelly, Sandy	30% or more coarse grained
With	
Sand, Gravel	15% or more coarse grained
Silt, Clay	5% to 12% fine grained
Trace	
Sand, Gravel	Less than 15% coarse grained
Silt, Clay	Less than 5% fine grained
Contains	Indicates presence only

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS: Unified Soil Classification Symbols are shown above as group symbols. Use A Line Chart for laboratory identification. Dual symbols are used for borderline classifications.

BOULDERS & COBBLES: Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12 inch size.

DISINTEGRATED ROCK: Residual rock material with Standard Penetration Resistance (SPT) of more than 60 blows per foot, and less than refusal. Refusal is defined as a SPT of 100 blows for 2" or less penetration.

ROCK FRAGMENTS: Angular pieces of rock, distinguished from transported gravel, which have separated from original vein or strata and are present in a soil matrix.

QUARTZ: A hard silica mineral often found in residual soils.

IRONITE: Iron oxide deposited within a soil layer forming cemented deposits.

CEMENTED SAND: Usually localized rock-like deposits within a soil stratum composed of sand grains cemented by calcium carbonate or other materials.

MICA: A soft plate of silica mineral found in many rocks, and in residual or transported soil derived therefrom.

ORGANIC MATERIALS (Excluding Peat):
- Topsoil - Surface soils that support plant life and which contain considerable amounts of organic matter;
- Organic Matter - Soil containing organic colloids throughout its structure;
- Lignite - Hard, brittle decomposed organic matter with low fixed carbon content (a low grade of coal).

FILL: Man-made deposit containing soil, rock and often foreign matter.

PROBABLE FILL: Soils which contain no visually detected foreign matter but which are suspect with regard to origin.

LENSES: 0 to 2 inch seam of minor soil component.

LAYERS: 2 to 12 inch seam of minor soil component.

POCKET: Discontinuous body of minor soil component.

COLOR SHADES: Light to dark to indicate substantial difference in color.

MOISTURE CONDITIONS: Wet, moist, or dry to indicate visual appearance of specimen.

Schnabel TEST BORING LOG	Project: East Side Berm, AWI Site Elm Avenue and Veneer Road Portsmouth, Virginia	Boring Number: **B-1** Contract Number: 10233031 Sheet: 1 of 2

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 2-15/16" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 11/23/10 Finished: 11/23/10

X: 3461197 ft Y: 12128373 ft

Ground Surface Elevation: 5± (ft) Total Depth: 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	11/23	10:50 AM	3.0'	---	---
After Drilling ▼	11/23	11:49 AM	3.6'	---	28.2'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Rootmat and topsoil		4.8					
1.4	FILL, sampled as silty sand, fine to coarse grained sand; moist, dark brown, contains gravel, loose	FILL	3.6	A		S-1, SPT 3+3+3+2 REC=20", 83%	PID = 0 ppm PID = 0 ppm	FILL
4.0	SILTY SAND, fine to medium grained sand; moist, brown, contains shell fragments, medium dense ▽ ▼ Change: wet, contains lean clay lenses	SM	1.0	B1		S-2, SPT 6+7+6+3 REC=20", 83%	MC = 20.5% % Passing #200 = 21.1 PID = 0 ppm	ALLUVIUM
6.0	POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, gray, very loose	SP-SM	-1.0	C1	5	S-3, SPT 1+1+1+1 REC=18", 75%	MC = 19.8% PID = 0 ppm	NORFOLK FORMATION
7.1	POORLY GRADED SAND, fine to medium grained sand; wet, gray, trace silt, very loose	SP	-2.1	C1		S-4, SPT 1+1+2+1 REC=20", 83%	PID = 0 ppm	Creosote odor observed in samples collected from 6 to 30 ft. Dark brown staining observed on 8 to 10 ft sample. Sheen observed on samples collected from 8 to 30 ft.
7.7	LEAN CLAY WITH SAND; wet, dark brown, soft	CL	-2.7	C2			PID = 3.0 ppm PP =0.25 tsf	
8.0	POORLY GRADED SAND, fine to medium grained sand; wet, brown, trace silt, contains organic matter, loose	SP	-3.0					
12.0	POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, gray, contains shell fragments, very loose	SP-SM	-7.0	C1	10	S-5, SPT 1+2+2+5 REC=20", 83%	PID = 4.1 ppm PID = 81.9 ppm	
	FAT CLAY; wet, gray, trace sand, very soft	CH		C2	15	S-6, SPT WOH/24" REC=24", 100%	PID = 4.4 ppm PP <0.25 tsf	
	Change: contains organic matter				20	S-7, SPT WOH/24" REC=24", 100%	PID = 0.3 ppm PP <0.25 tsf	
						S-8, SPT WOH/24" REC=24", 100%	PID = 4.8 ppm PP <0.25 tsf	

(continued)

Schnabel TEST BORING LOG	Project: East Side Berm, AWI Site Elm Avenue and Veneer Road Portsmouth, Virginia	Boring Number: B-1 Contract Number: 10233031 Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	FAT CLAY; wet, gray, trace sand, very soft *(continued)*	CH		C2		S-9, SPT WOH/12"+1+1 REC=24", 100%	PID = 0 ppm PP =0.25 tsf PID = 0 ppm	NORFOLK FORMATION
29.0	CLAYEY SAND, fine to medium grained sand; wet, brown brown, contains organic matter, very loose	SC	-24.0	C1				
30.0			-25.0		30			

Bottom of Boring at 30.0 ft.
Boring backfilled with cuttings upon completion.

Schnabel TEST BORING LOG	Project: East Side Berm, AWI Site Elm Avenue and Veneer Road Portsmouth, Virginia	Boring Number: B-2 Contract Number: 10233031 Sheet: 1 of 1

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 2-15/16" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 11/23/10 Finished: 11/23/10

X: 3461230 ft Y: 12128519 ft

Ground Surface Elevation: 5± (ft) Total Depth: 20.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ∇	11/23	12:10 PM	3.8'	---	---
After Drilling ∇	11/23	12:37 PM	4.1'	---	---
Observation Well ▼	11/24	7:33 AM	5.9'	---	---

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Rootmat and topsoil		4.8			S-1, SPT 4+3+2+3 REC=14", 58%	PID = 0 ppm	FILL
	FILL, sampled as silty sand, fine to coarse grained sand; moist, dark brown, contains brick fragments, wood fragments, crushed stone, loose	FILL		A		S-2, SPT 6+3+2+1 REC=3", 13%	PID = 0.2 ppm	2 to 4 ft sample consists of brick fragments and crushed stone.
					5	S-3, SPT 1/12"+2+1 REC=1", 4%	PID = 0 ppm	Piece of gravel lodged in boot of spoon.
6.0	POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, gray, very loose	SP-SM	-1.0	B1		S-4, SPT 1+2+1/12" REC=18", 75%	PID = 0.3 ppm	ALLUVIUM Creosote odor observed from 6 to 10 ft.
	Change: contains organic matter, lean clay pockets				10	S-5, SPT 1+1+1+4 REC=20", 83%	PID = 0.3 ppm	Dark brown staining observed on sample.
12.0	POORLY GRADED SAND, fine to medium grained sand; wet, gray, trace silt, loose	SP	-7.0	C1	15	S-6, SPT 4+4+2+1 REC=20", 83%	PID = 0 ppm	NORFOLK FORMATION No return water.
17.0	FAT CLAY; wet, gray, trace sand, very soft	CH	-12.0	C2		S-7, SPT WOH+1/18" REC=24", 100%	PID = 0 ppm PP <0.25 tsf	
20.0			-15.0		20			

Bottom of Boring at 20.0 ft.
Temporary well installed upon completion.

Schnabel TEST BORING LOG	Project: East Side Berm, AWI Site Elm Avenue and Veneer Road Portsmouth, Virginia	Boring Number: B-3 Contract Number: 10233031 Sheet: 1 of 1

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 2-15/16" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 11/23/10 Finished: 11/23/10

X: 3461267 ft Y: 12128662 ft

Ground Surface Elevation: 4± (ft) Total Depth: 20.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ∇	11/23	12:55 PM	2.0'	---	---
After Drilling ∇	11/23	1:49 PM	3.2'	---	---

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Rootmat and topsoil		3.7					
	FILL, sampled as silty sand, fine to coarse grained sand; moist, dark brown, contains brick fragments, wood fragments, roots, loose ∇ Change: wet ∇	FILL		A		S-1, SPT 2+2+4+9 REC=18", 75%	PID = 0 ppm	FILL
						S-2, SPT 2+1+2+1 REC=20", 83%	PID = 0 ppm	Majority of 2 to 4 and 4 to 6ft samples is wood.
					5	S-3, SPT 3+1/18" REC=18", 75%	PID = 0.1 ppm	Creosote odor observed from 4 to 20 ft.
6.0	LEAN CLAY; wet, dark brown, contains organic matter, very soft	CL	-2.0	B2		S-4, SPT WOH+1/18" REC=24", 100%	MC = 73.6% PID = 7.2 ppm PP <0.25 tsf	ALLUVIUM
8.0	SILTY SAND, fine to medium grained sand; wet, gray, contains organic matter, loose	SM	-4.0	C1	10	S-5, SPT 2+3+2+2 REC=20", 83%	PID = 0.2 ppm	NORFOLK FORMATION
12.0	FAT CLAY WITH SAND; wet, gray, soft	CH	-8.0	C2	15	S-6, SPT 1+1+1/12" REC=24", 100%	PID = 0.1 ppm PP <0.25 tsf	No return water.
	Change: contains shell fragments					S-7, SPT 1+1+2+1 REC=3", 13%	PID = 0.7 ppm PP =1.75 tsf	
20.0			-16.0		20			

Bottom of Boring at 20.0 ft.
Boring backfilled with cuttings upon completion.

Schnabel TEST BORING LOG

Project: East Side Berm, AWI Site
Elm Avenue and Veneer Road
Portsmouth, Virginia

Boring Number: **B-4**
Contract Number: 10233031
Sheet: 1 of 2

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 2-15/16" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 11/23/10 Finished: 11/23/10

X: 3461343 ft Y: 12128800 ft

Ground Surface Elevation: 3± (ft) Total Depth: 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	11/23	2:21 PM	2.0'	---	---
After Drilling ▽	11/23	3:08 PM	2.2'	---	---
Observation Well ▼	11/24	7:39 AM	3.4'	---	---

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	LITTER ROOTMAT TOPS		2.7			S-1, SPT 4+3+1/12" REC=16", 67%	PID = 0 ppm	ALLUVIUM
	CLAYEY SAND, fine to medium grained sand; moist, dark brown, trace gravel, contains organic matter, loose	SC						
2.0	SILTY SAND, fine to medium grained sand; wet, gray, contains fat clay pockets, loose		1.0			S-2, SPT 3+3+4+4 REC=20", 83%	LL = NP MC = 19.1% % Passing #200 = 13.8 PID = 0 ppm	
					5	S-3, SPT 3+4+1+1 REC=22", 92%	MC = 22.4% PID = 0 ppm	
		SM		B1		S-4, SPT 1+2+2+1 REC=22", 92%	MC = 18.3% PID = 0 ppm	
	Change: brown gray					S-5, SPT 1+1+4+4 REC=24", 100%	MC = 21.9% PID = 0 ppm	
					10			
12.0	FAT CLAY; wet, gray, trace sand, very loose		-9.0					NORFOLK FORMATION
						S-6, SPT WOH/24" REC=24", 100%	PID = 0 ppm PP <0.25 tsf	
					15			
		CH		C2		S-7, SPT WOH/12"+1+1 REC=24", 100%	PID = 0 ppm PP =0.25 tsf	
	Change: contains shell fragments, organic matter				20			
						S-8, SPT 1+1/12"+1 REC=24", 100%	PID = 0 ppm PP =0.25 tsf	

(continued)

Schnabel TEST BORING LOG	Project: East Side Berm, AWI Site Elm Avenue and Veneer Road Portsmouth, Virginia	Boring Number: B-4 Contract Number: 10233031 Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	FAT CLAY; wet, gray, trace sand, very loose *(continued)*	CH		C2		S-9, SPT 1+1+1+1 REC=24", 100%	PID = 0 ppm PP =0.50 tsf	NORFOLK FORMATION
30.0			-27.0		30			

Bottom of Boring at 30.0 ft.
Temporary well installed upon completion.
Boring offset 25 ft northeast due to underground utilities.

Schnabel TEST BORING LOG

Project: East Side Berm, AWI Site
Elm Avenue and Veneer Road
Portsmouth, Virginia

Boring Number: **B-5**
Contract Number: 10233031
Sheet: 1 of 1

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 3-7/8" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 11/23/10 Finished: 11/23/10

X: 3461447 ft Y: 12128902 ft

Ground Surface Elevation: 4± (ft) Total Depth: 20.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	11/23	3:34 PM	1.6'	---	---
After Drilling ▼	11/23	3:59 PM	1.9'	---	---

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	POORLY GRADED SAND, fine to medium grained sand; moist, light brown, trace silt, very loose	SP		B1		S-1, SPT WOH/12"+1+2 REC=20", 83%	PID = 0 ppm MC = 20.7%	ALLUVIUM
1.6	LEAN CLAY WITH SAND; wet, light gray, contains silty sand layers, very soft	CL	2.4	B2		1, UNDIST REC=11", 46%	PID = 0.3 ppm PP =0.75 tsf PP = 0.75 tsf	Tube material not very good; will offset and attempt an additional tube.
3.5	Change: brown		0.5					
	POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, brown	SP-SM		B1	5	S-2, SPT 1+2+1+2 REC=22", 92%	MC = 17.0% PID = 0 ppm	
						S-3, SPT 3+2+1+2 REC=24", 100%	MC = 19.6% PID = 0 ppm	
						S-4, SPT 1+2+1+1 REC=22", 92%		
	Change: gray brown				10			
12.0	FAT CLAY; wet, gray, trace sand, very soft	CH	-8.0	C2				NORFOLK FORMATION
					15	S-5, SPT 1/12"+1/12" REC=24", 100%	PID = 0 ppm PP <0.25 tsf	
						S-6, SPT WOH+1/12"+1 REC=24", 100%	PID = 0 ppm PP =0.50 tsf	
20.0			-16.0		20			

Bottom of Boring at 20.0 ft.
Boring backfilled with cuttings upon completion.

Schnabel TEST BORING LOG	Project: East Side Berm, AWI Site Elm Avenue and Veneer Road Portsmouth, Virginia	Boring Number: B-5A Contract Number: 10233031 Sheet: 1 of 1

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 3-7/8" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 11/23/10 Finished: 11/23/10

Ground Surface Elevation: 4± (ft) Total Depth: 3.5 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	Mud rotary probe to 1.5 ft; see Boring Log B-5 for strata description.							
1.5	LEAN CLAY WITH SAND; wet, light gray	CL	2.5	B2		1, UNDIST REC=17", 71%	LL = 42 PL = 16 MC = 26.3% % Passing #200 = 73.2 PP =0.75 tsf	ALLUVIUM
3.5			0.5					

Bottom of Boring at 3.5 ft.
Boring backfilled with cuttings upon completion.
Boring offset 1 ft south of B-5.

Schnabel TEST BORING LOG	Project: East Side Berm, AWI Site Elm Avenue and Veneer Road Portsmouth, Virginia	Boring Number: **B-6** Contract Number: 10233031 Sheet: 1 of 2

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 3-7/8" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 11/24/10 Finished: 11/24/10

X: 3461576 ft Y: 12129171 ft

Ground Surface Elevation: 5± (ft) Total Depth: 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ∇	11/24	9:09 AM	4.0'	---	---
After Drilling ∇	11/24	10:01 AM	4.6'	---	---
W.O.W.	12/15	2:04 PM	4.3'	---	---

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.4	LITTER ROOTMAT TOPS		4.6			S-1, SPT 3+8+8+1 REC=20", 83%	PID = 0 ppm	FILL
2.0	FILL, sampled as silty sand, fine to coarse grained sand; moist, brown gray, contains concrete fragments, medium dense	FILL	3.0	A				
4.0	SILTY SAND, fine to medium grained sand; moist, dark brown, contains lean clay pockets, organic matter, loose	SM	1.0	B1		S-2, SPT 2+4+3+4 REC=20", 83%	MC = 31.4% PID = 0 ppm	ALLUVIUM
7.0	SANDY FAT CLAY; wet, brown gray, medium dense	CH	-2.0	B2	5	S-3, SPT 1+4+2+2 REC=24", 100% S-4, SPT 3+4+4+4 REC=24", 100%	LL = 21 PL = 15 MC = 20.1% % Passing #200 = 25.3 PID = 0 ppm PP =0.75 tsf MC = 17.4% PID = 0 ppm	
12.0	SILTY SAND, fine to medium grained sand; wet, brown, contains fat clay lenses, loose	SM	-7.0	B1	10	S-5, SPT 4+3+2+3 REC=24", 100%	PP =0.50 tsf PID = 0 ppm MC = 22.3% PID = 0 ppm	
14.5	POORLY GRADED SAND, fine to medium grained sand; wet, orange brown, trace silt, medium dense	SP	-9.5			S-6, SPT 5+7+6+7 REC=24", 100%	PID = 0 ppm	
17.0	POORLY GRADED SAND, fine to medium grained sand; wet, dark gray, trace silt, medium dense	SP	-12.0	C1	15		PID = 0 ppm	NORFOLK FORMATION
20.0	FAT CLAY; wet, gray, trace sand, contains organic matter, very soft	CH	-15.0			S-7, SPT WOH/24" REC=24", 100%	PID = 0 ppm PP <0.25 tsf	
	FAT CLAY; wet, gray, trace sand, contains organic matter	CH		C2	20	1, UNDIST REC=24", 100% S-8, SPT WOH/18"+1 REC=24", 100%	LL = 64 PL = 28 MC = 79.8% % Passing #200 = 98.7 PP =0.50 tsf PID = 0 ppm PP =0.25 tsf	

(continued)

Schnabel TEST BORING LOG	Project: East Side Berm, AWI Site Elm Avenue and Veneer Road Portsmouth, Virginia	Boring Number: **B-6** Contract Number: 10233031 Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
25.0	FAT CLAY; wet, gray, trace sand, contains organic matter	CH	-20.0	C2		2, UNDIST REC=24", 100%	PP =0.75 tsf	NORFOLK FORMATION
						S-9, SPT WOH+1+1+1 REC=24", 100%	PID = 0 ppm PP =0.25 tsf	
30.0			-25.0		30			

Bottom of Boring at 30.0 ft.
Temporary well installed upon completion.

Schnabel TEST BORING LOG	Project: East Side Berm, AWI Site Elm Avenue and Veneer Road Portsmouth, Virginia	Boring Number: B-6A Contract Number: 10233031 Sheet: 1 of 1

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 3-7/8" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 11/24/10 Finished: 11/24/10

Ground Surface Elevation: 5± (ft) Total Depth: 6.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	Change: Mud rotary probe to 4 ft; see Boring Log B-6 for strata descriptions.							
6.0	SANDY FAT CLAY; wet, brown gray	CH	-1.0	B2	5	S-1, SH	LL = NP MC = 19.1% % Passing #200 = 15.7 PP = 1.00 tsf	ALLUVIUM

Bottom of Boring at 6.0 ft.
Boring backfilled with cuttings upon completion.
Boring offset 1ft west of B-6.

Schnabel TEST BORING LOG	Project: Remedial Design AWI Superfund Site, Elm Avenue, Portsmouth, Virginia	Boring Number: L-1 Contract Number: 08330092 Sheet: 1 of 3

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 3-7/8" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 9/29/08 Finished: 9/29/08

X: 3461650 ft Y: 12129268 ft

Ground Surface Elevation: 6± (ft) Total Depth: 65.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ∇	9/29	11:37 AM	4.0'	---	---
Completion ▼	9/29	1:06 PM	4.3'	---	---
Casing Pulled ▼	9/29	1:09 PM	4.3'	5.0'	56.7'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Forest litter, rootmat and topsoil		5.7			S-1, SPT 1+1+1+3 REC=5", 21%		FILL
	FILL, sampled as silty sand, fine to coarse grained sand; moist, grayish brown, contains lean clay layers, contains crushed stone, contains brick fragments	FILL		A		S-2, SPT 3+3+5+3 REC=22", 92%		
4.0	Change: estimated 5 - 10% shells		2.0			S-3, SPT 3+3+2+2 REC=24", 100%	PP =1.25 tsf	ALLUVIUM
	SANDY FAT CLAY; wet, grayish brown, contains roots	CH		B2	5			
6.0	SILTY SAND, fine to medium grained sand; wet, brown		0.0			S-4, SPT 3+4+5+5 REC=24", 100%		NORFOLK FORMATION
						S-5, SPT 5+4+5+4 REC=24", 100%		
		SM			10			
	Change: yellowish brown			C1		S-6, SPT 2+3+3+6 REC=24", 100%		
					15			
17.0	CLAYEY SAND, fine to medium grained sand; wet, gray, contains silty sand pockets	SC	-11.0			S-7, SPT WOH/18"+1 REC=24", 100%		
					20			
22.0	LEAN CLAY; moist, dark gray, contains mica	CL	-16.0	C2		S-8, SPT WOR+WOH+1+1 REC=24", 100%	PP =0.25 tsf	

(continued)

Schnabel Engineering TEST BORING LOG

Project: Remedial Design AWI Superfund Site
Elm Avenue
Portsmouth, Virginia

Boring Number: L-1
Contract Number: 08330092
Sheet: 2 of 3

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
		CL						NORFOLK FORMATION
26.0	LEAN CLAY WITH SAND; moist, greenish gray, contains mica	CL	-20.0	C2		UD-1 REC=24", 100%	PP =0.50 tsf	
					30	S-9, SPT WOH/12"+1+1 REC=24", 100%	PP =0.25 tsf	
32.0	ELASTIC SILT; moist, greenish gray, estimated <5% sand	MH	-26.0			S-10, SPT 1+1+1+1 REC=24", 100%	PP =0.75 tsf	
					35			
					40	S-11, SPT WOH/12"+1+1 REC=24", 100%	PP =0.50 tsf	
	Change: WITH SAND; estimated <5% shells				45	S-12, SPT 1+1+1+1 REC=24", 100%	PP =0.50 tsf	
47.0	FAT CLAY; moist, gray, estimated <5% sand	CH	-41.0		50	S-13, SPT 1+1+2+2 REC=24", 100%	PP =0.50 tsf	
					55	S-14, SPT 1+2+2+3 REC=24", 100%	PP = 0.75 tsf	
57.0	SILTY SAND, fine to medium grained sand; wet, gray	SM	-51.0	C1		S-15, SPT		

(continued)

TEST BORING LOG 08330092 CORRECTIONS 1-30-09.GPJ SCHNABEL DATA TEMPLATE 2008_07_05.GDT 2/18/11

Schnabel Engineering TEST BORING LOG	Project: Remedial Design AWI Superfund Site, Elm Avenue, Portsmouth, Virginia	Boring Number: L-1; Contract Number: 08330092; Sheet: 3 of 3

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SILTY SAND, fine to medium grained sand; wet, gray *(continued)*	SM		C1	60	3+7+11+10 REC=24", 100%		NORFOLK FORMATION
						S-16, SPT 3+3+3+5 REC=24", 100%		
65.0			-59.0		65			

Bottom of Boring at 65.0 ft.
Boring backfilled with cement/bentonite grout upon completion.

Schnabel ENGINEERING **TEST BORING LOG**

Project: Remedial Design AWI Superfund Site
Elm Avenue
Portsmouth, Virginia

Boring Number: L-4
Contract Number: 08330092
Sheet: 1 of 2

Contractor: Fishburne Drilling, Inc.
Chesapeake, Virginia

Contractor Foreman: E. Hester

Schnabel Representative: R. Rountree

Equipment: CME-45C (Track)

Method: 3-7/8" O.D. Tri-cone Roller Bit

Hammer Type: Auto Hammer (140 lb)

Dates Started: 9/26/08 Finished: 9/26/08

X: 3461535 ft Y: 12129036 ft

Ground Surface Elevation: 6± (ft) Total Depth: 40.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	9/26	11:05 AM	4.0'	---	---
Completion ▼	9/26	11:46 AM	4.5'	---	---
Casing Pulled ▼	9/26	11:49 AM	4.5'	5.0'	36.8'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Forest litter, rootmat and topsoil		5.2			S-1, SPT 1+2+4+4 REC=24", 100%	PP =2.25 tsf	ALLUVIUM
	FAT CLAY WITH SAND; moist, yellowish brown Change: contains roots	CH		B2		S-2, SPT 3+5+5+5 REC=24", 100%	PP =1.75 tsf	
4.0	SILTY SAND, fine to medium grained sand; wet, grayish brown, contains clayey sand lenses		1.5		5	S-3, SPT 6+6+6+5 REC=24", 100%		
						S-4, SPT 3+4+3+3 REC=24", 100%		
	Change: brownish gray	SM		B1		S-5, SPT 1+2+2+2 REC=24", 100%		
					10			
12.0	POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, gray	SP-SM	-6.5	C1		S-6, SPT 2+4+5+5 REC=24", 100%		NORFOLK FORMATION
					15			
17.0	FAT CLAY; wet, gray, estimated <5% sand		-11.5			S-7, SPT WOH/24" REC=2", 8%	PP <0.25 tsf	
		CH		C2	20	UD-1 REC=23", 96%	MC = 85.5% PP =0.75 tsf	
						S-8, SPT WOH/12"+1+1 REC=24", 100%	PP <0.25 tsf	

(continued)

Schnabel Engineering TEST BORING LOG	Project: Remedial Design AWI Superfund Site Elm Avenue Portsmouth, Virginia	Boring Number: L-4 Contract Number: 08330092 Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	FAT CLAY; wet, gray, estimated <5% sand *(continued)*	CH						NORFOLK FORMATION
27.0	ELASTIC SILT; moist, gray, estimated <5% sand	MH	-21.5	C2		S-9, SPT 1+1+1+1 REC=24", 100%	PP =0.25 tsf	
					30			
						S-10, SPT WOH+1+1+1 REC=24", 100%	PP =0.75 tsf	
					35			
						S-11, SPT 1+1+1+2 REC=24", 100%	PP =0.50 tsf	
40.0			-34.5		40			

Bottom of Boring at 40.0 ft.
Boring backfilled with cement/bentonite grout upon completion.

APPENDIX C

GEOTECHNICAL ANALYSIS

Plates C1.x - Steady State Seepage Analysis (x = Section 1 or 2)

Plate C1.1 – Section 1 material assignment.
Plate C1.1a-el10.0 – Section 1 Impounded phreatic surface at El 10.0.
Plate C1.1b-el08.5 – Section 1 Impounded phreatic surface at El 8.5.
Plate C1.1c-el07.0 – Section 1 Impounded phreatic surface at El 7.0.

Plate C1.2 – Section 2 material assignments.
Plate C1.2a-el10.0 – Section 2 Impounded phreatic surface at El 10.0.
Plate C1.2b-el08.5 – Section 2 Impounded phreatic surface at El 8.5.
Plate C1.2c-el07.0 – Section 2 Impounded phreatic surface at El 7.0.

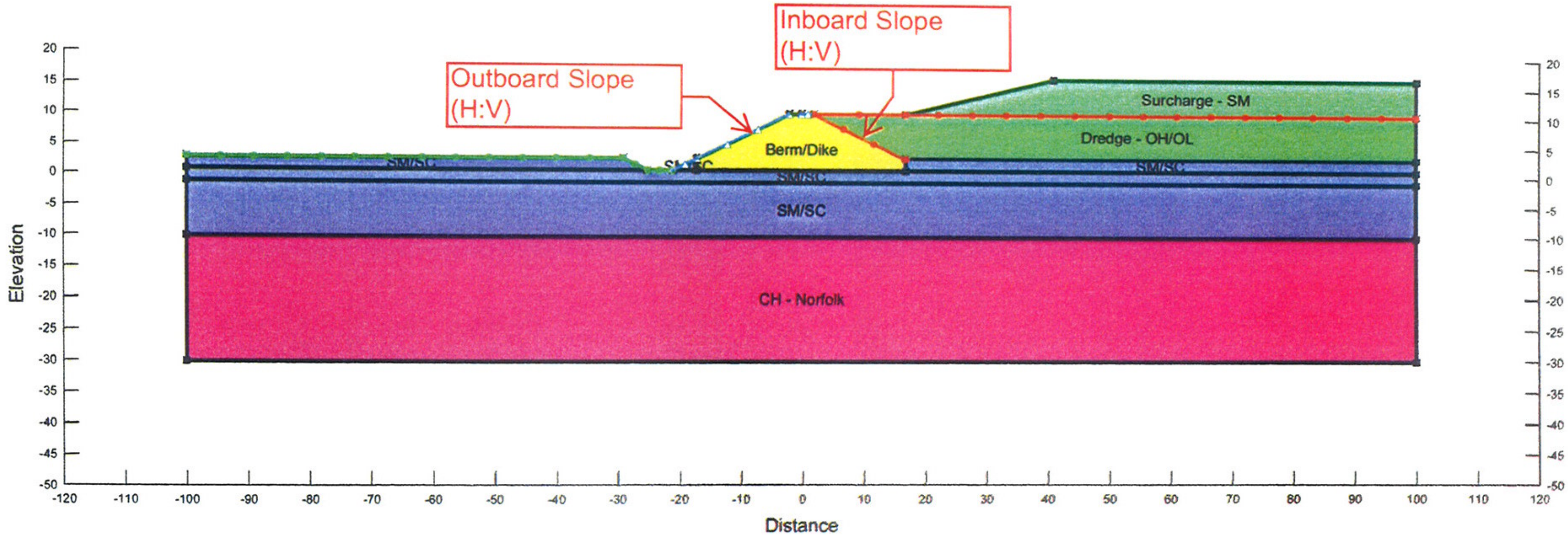
Plates C2.x – Global Slope Stability Analysis (x = Section 1 or 2)

Figure C2.1u – Section 1 material assignment (undrained case – short term).
Plate C2.1a-el10.0u – Section 1 Impounded phreatic surface at El 10.0 (undrained case – short term).

Figure C2.1d – Section 1 material assignment (drained case – long term).
Plate C2.1a-el10.0d – Section 1 Impounded phreatic surface at El 10.0 (drained case – long term).
Plate C2.1b-el08.5d – Section 1 Impounded phreatic surface at El 8.5 (drained case – long term).
Plate C2.1c-el07.0d – Section 1 Impounded phreatic surface at El 7.0 (drained case – long term).

Figure C2.2u – Section 2 material assignment (undrained case – short term).
Plate C2.2a-el10.0u – Section 2 Impounded phreatic surface at El 10.0 (undrained case – short term).

Figure C2.2d – Section 2 material assignment (drained case – long term).
Plate C2.2a-el10.0d – Section 2 Impounded phreatic surface at El 10.0 (drained case – long term).
Plate C2.2b-el08.5d – Section 2 Impounded phreatic surface at El 8.5 (drained case – long term).
Plate C2.2c-el07.0d – Section 2 Impounded phreatic surface at El 7.0 (drained case – long term).



Name: Berm/Dike Model: Saturated Only K-Sat: 8.9e-008 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
Name: Dredge - OH/OL Model: Saturated Only K-Sat: 3.3e-008 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
Name: Surcharge - SM Model: Saturated Only K-Sat: 8.2e-007 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
Name: SM/SC Model: Saturated Only K-Sat: 8.2e-007 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
Name: CH - Norfolk Model: Saturated Only K-Sat: 8.9e-008 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Schnabel ENGINEERING

Remedial Design AWI Superfund Site
Elm Avenue
Portsmouth, Virginia

SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5

File Name: Plate C1.1.gsz
Name: Transient Seepage
Last Edited By: Scott Raschke
Date: 2/21/2011 Time: 2:23:45 PM
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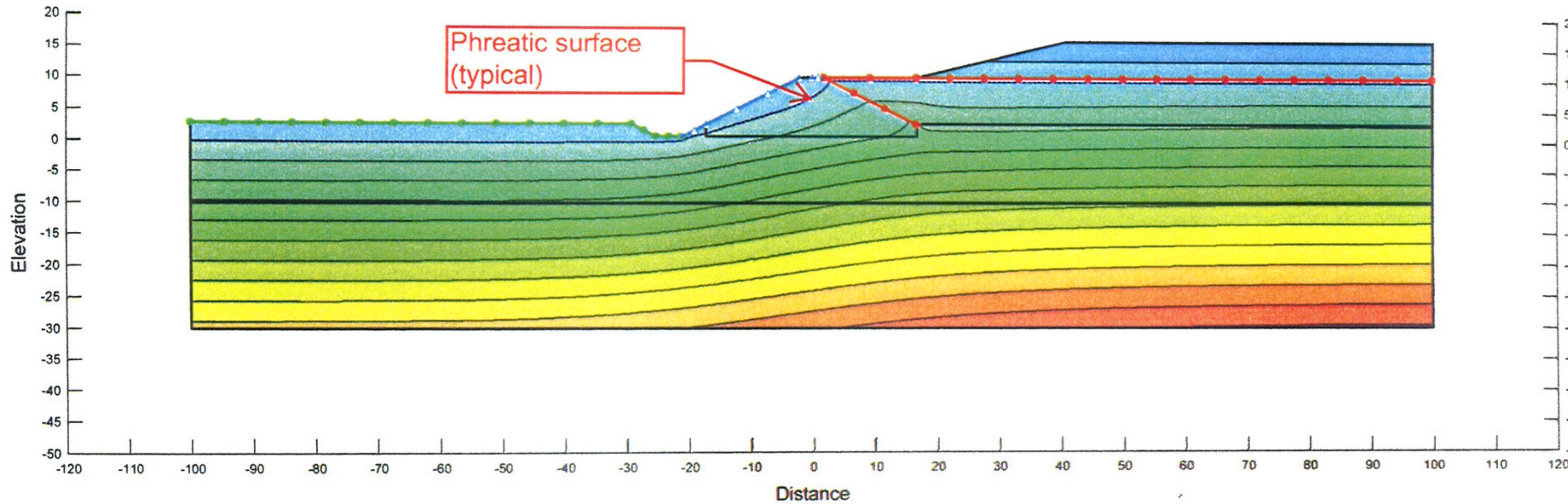

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Name: Surcharge - SM Model: Saturated Only K-Sat: 8.2e-007 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
Name: SM/SC Model: Saturated Only K-Sat: 8.2e-007 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
Name: CH - Norfolk Model: Saturated Only K-Sat: 8.9e-008 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

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SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5

File Name: Plate C1.1a-el10.0.gsz
Name: Transient Seepage
Last Edited By: Scott Raschke
Date: 2/21/2011 Time: 2:06:45 PM
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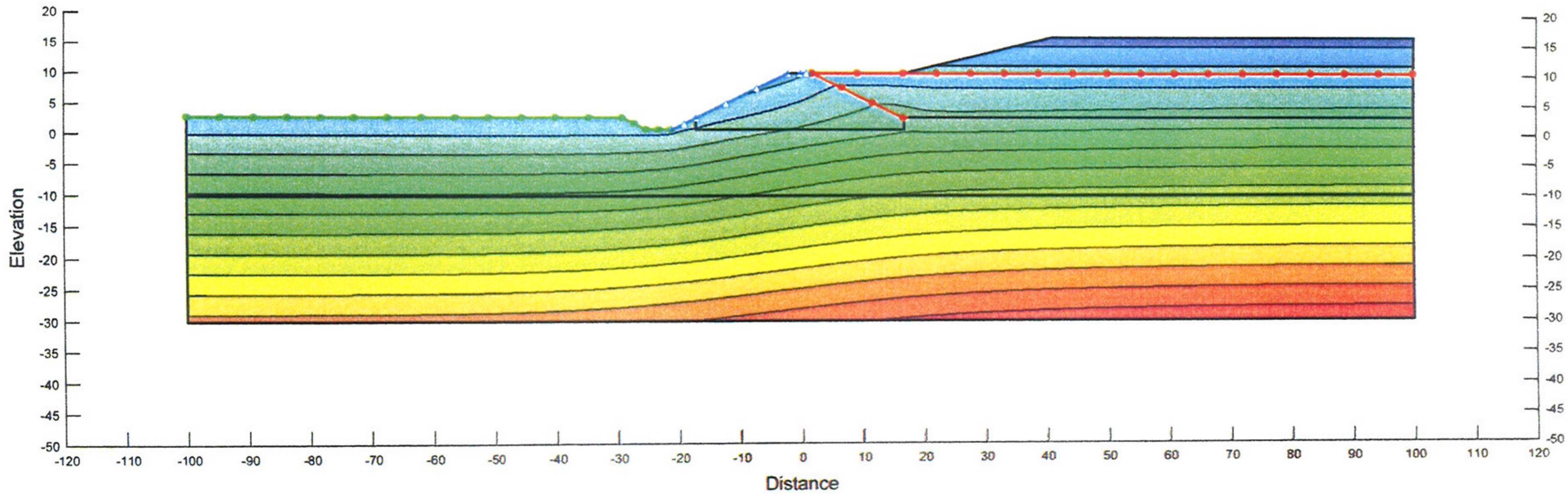

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Name: CH - Norfolk Model: Saturated Only K-Sat: 8.9e-008 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

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SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5

File Name: Plate C1.1b-el08.5.gsz
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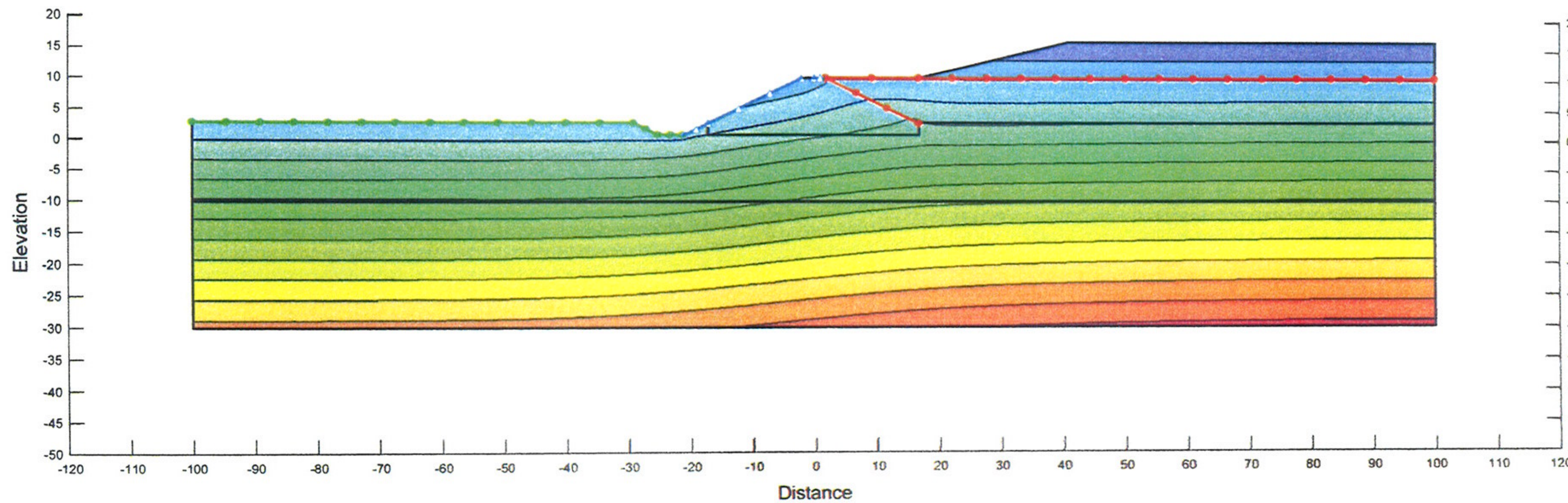

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SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5

File Name: Plate C1.1c-I07.0.gsz
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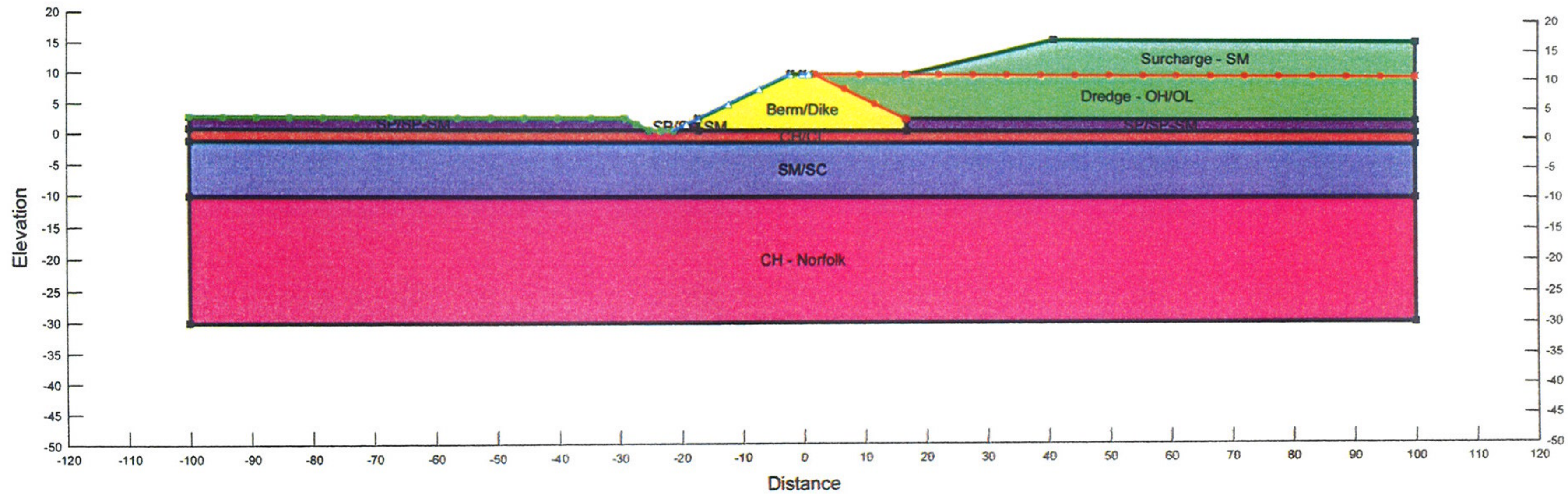

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Name: SP/SP-SM Model: Saturated Only K-Sat: 3.3e-006 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
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Name: CH/CL Model: Saturated Only K-Sat: 8.9e-008 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

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SECTION No. 2
Dredge Material at EL 10.5
Surcharge at EL 16.5

File Name: Plate C1.2.gsz
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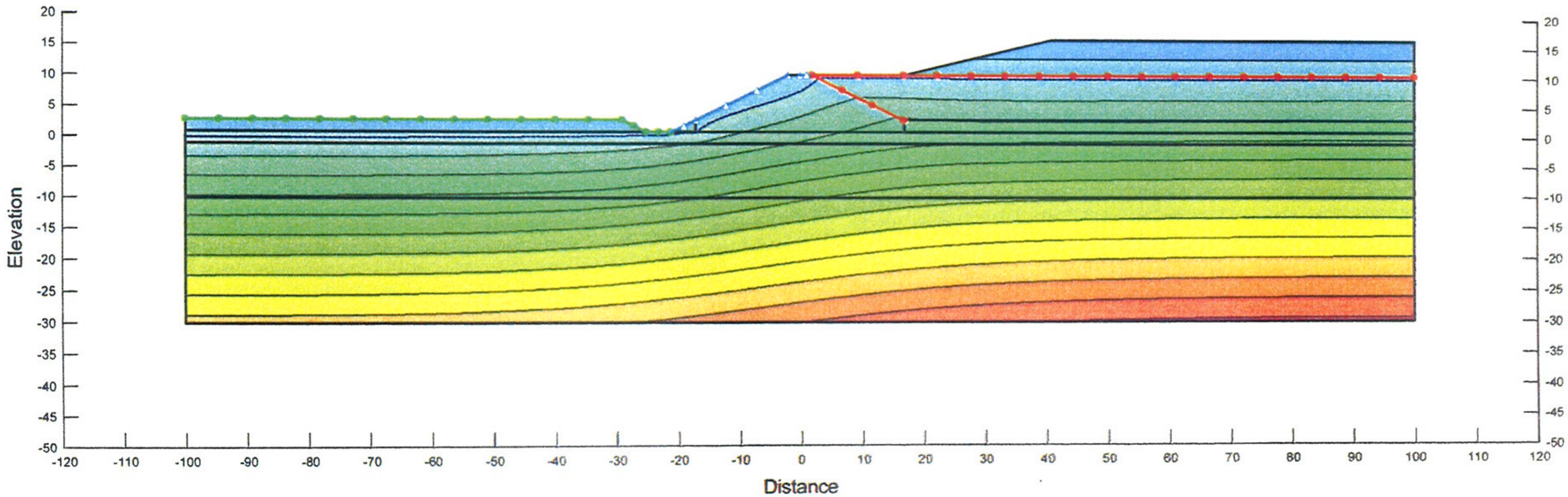

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Name: SP/SP-SM Model: Saturated Only K-Sat: 3.3e-006 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
Name: CH - Norfolk Model: Saturated Only K-Sat: 8.9e-008 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
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SECTION No. 2
Dredge Material at EL 10.5
Surcharge at EL 16.5

File Name: Plate C1.2a-el10.0.gsz
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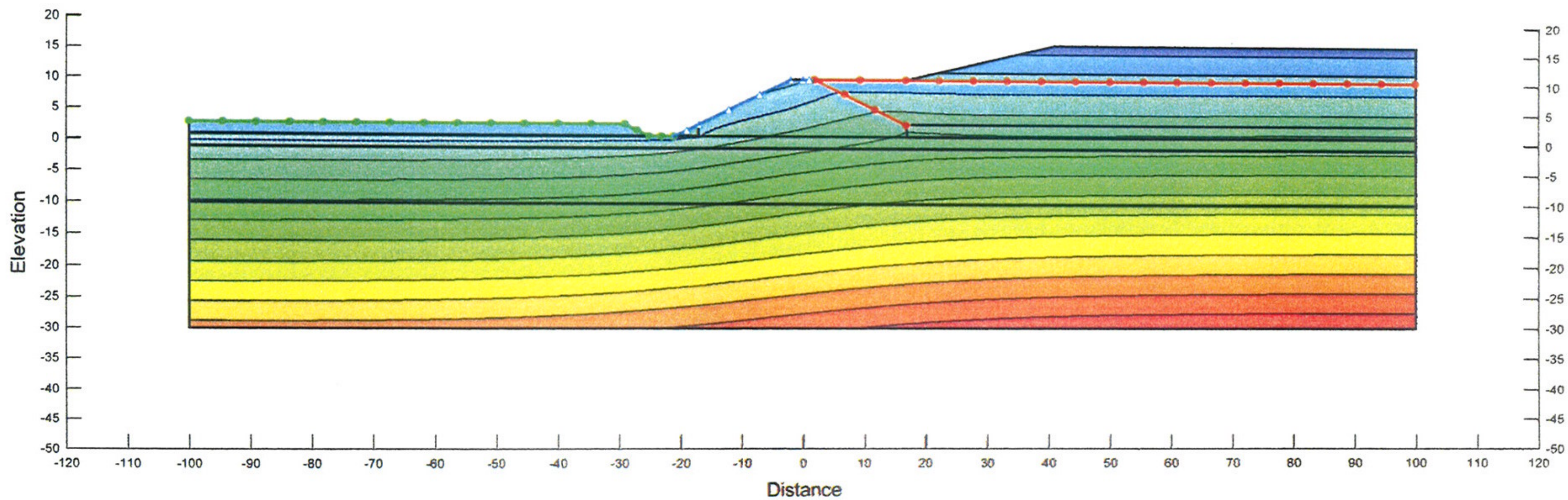

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Name: CH - Norfolk Model: Saturated Only K-Sat: 8.9e-008 ft/sec Volumetric Water Content: 0 ft³/ft³ Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °
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Surcharge at EL 16.5

File Name: Plate C1.2b-el08.5.gsz
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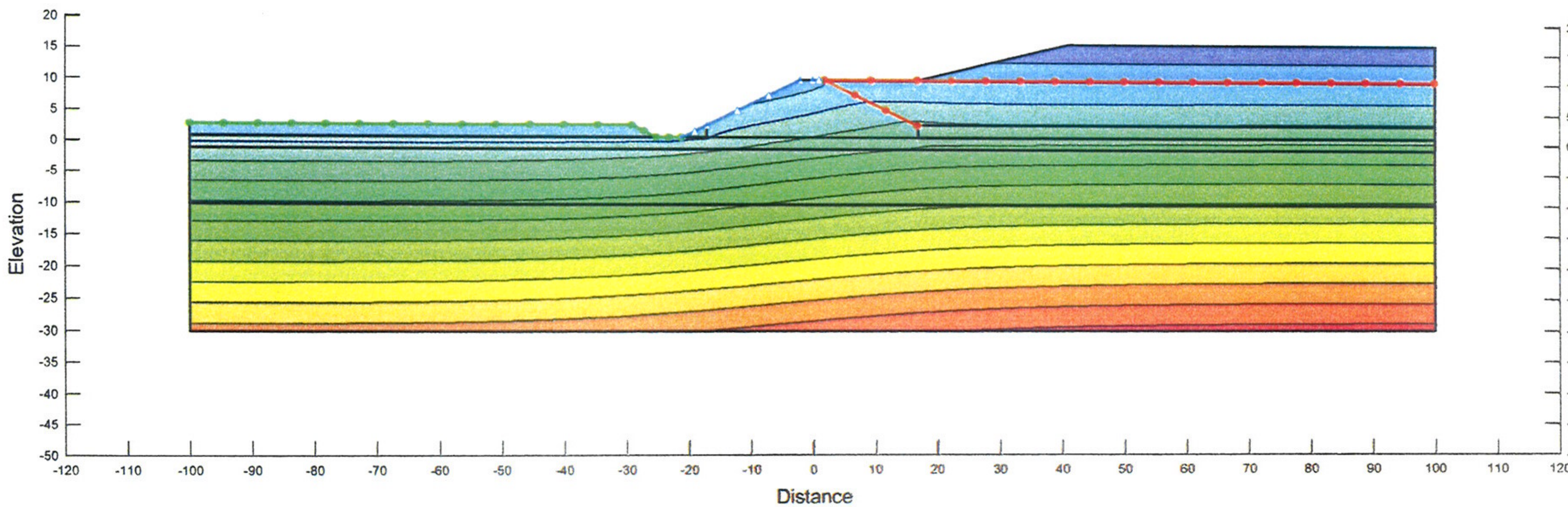

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SECTION No. 2
Dredge Material at EL 10.5
Surcharge at EL 16.5

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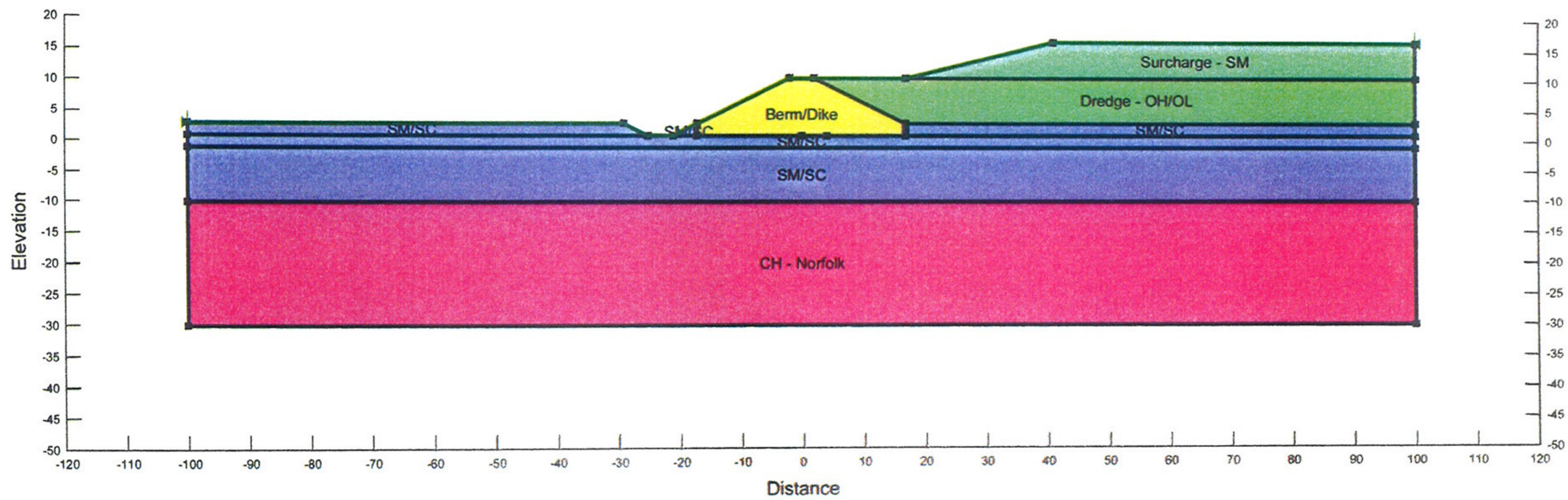

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Name: Surcharge - SM Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 38 °
Name: SM/SC Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34 °
Name: CH - Norfolk Model: Undrained (Phi=0) Unit Weight: 100 pcf Cohesion: 350 psf

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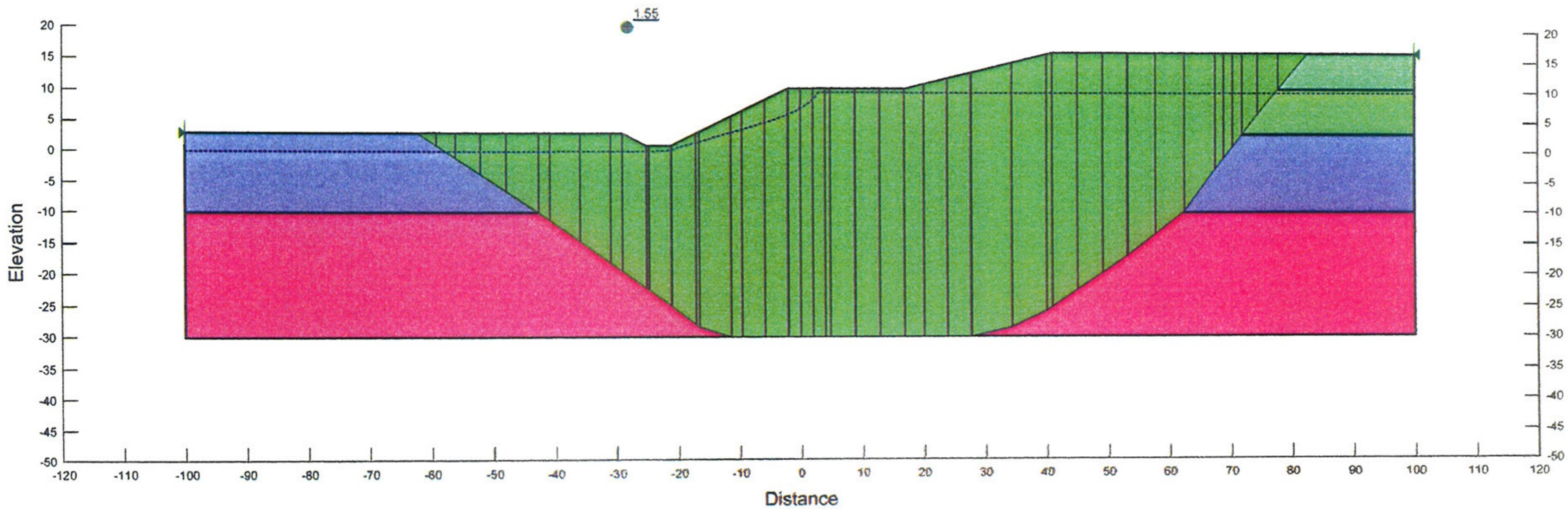
SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5



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Name: Surcharge - SM Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 38 °
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SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5

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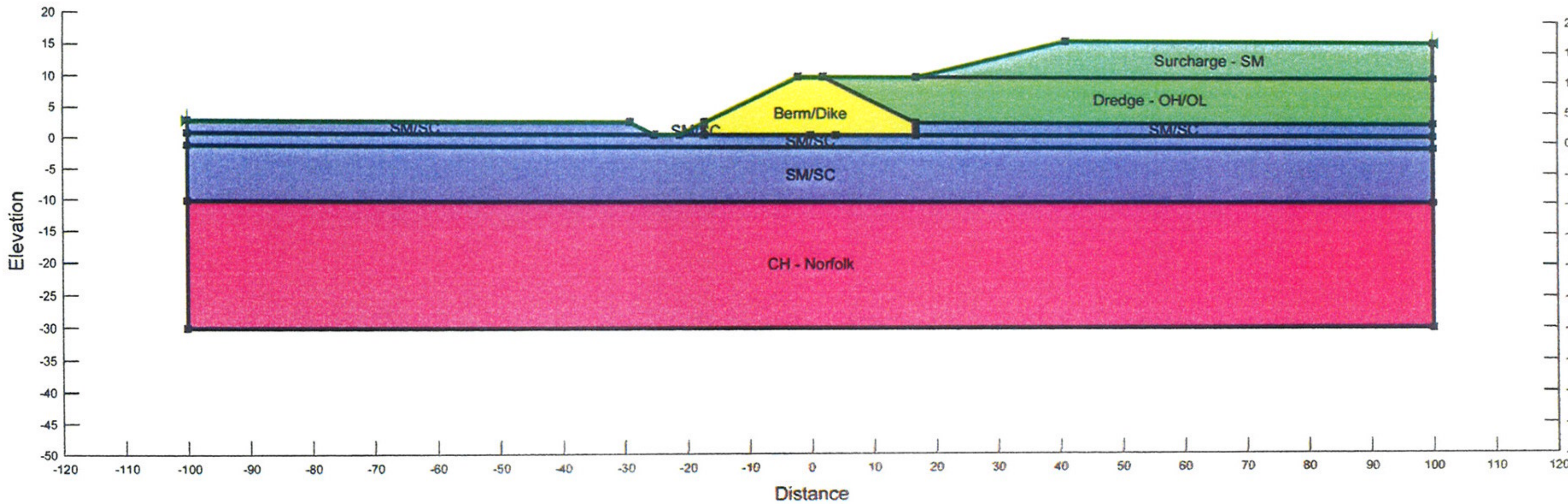

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Name: Surcharge - SM Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 38 °
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Remedial Design AWI Superfund Site
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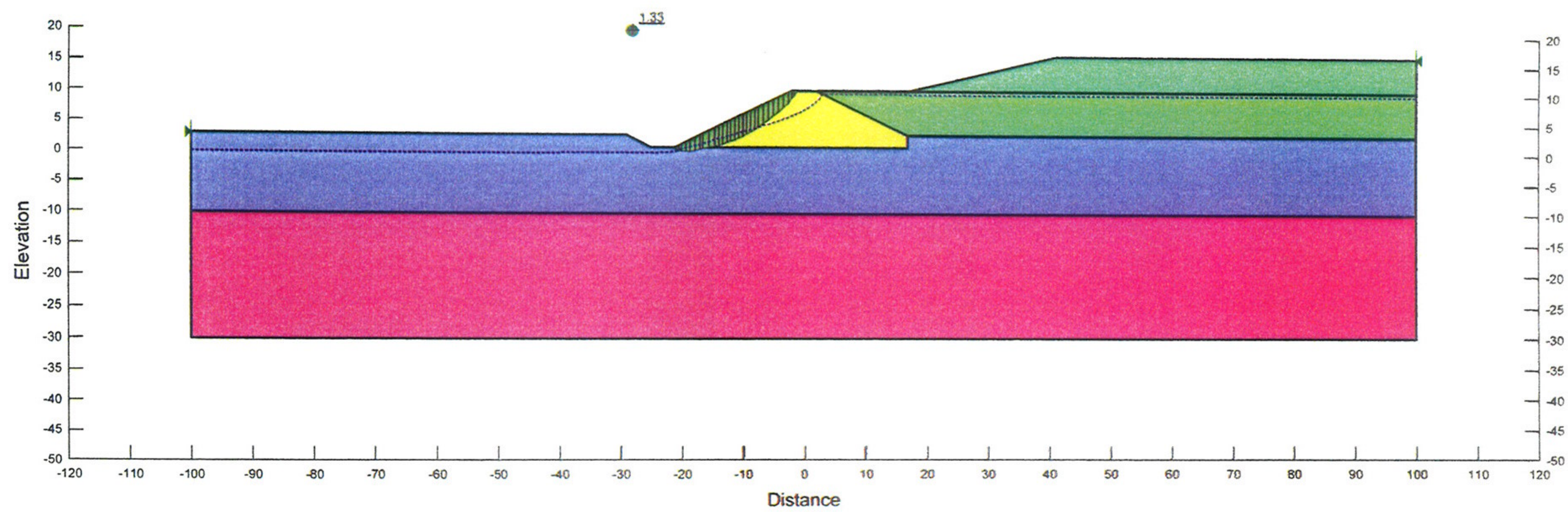
SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5



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Name: SM/SC Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34 °
Name: CH - Norfolk Model: Undrained (Phi=0) Unit Weight: 100 pcf Cohesion: 350 psf

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SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5

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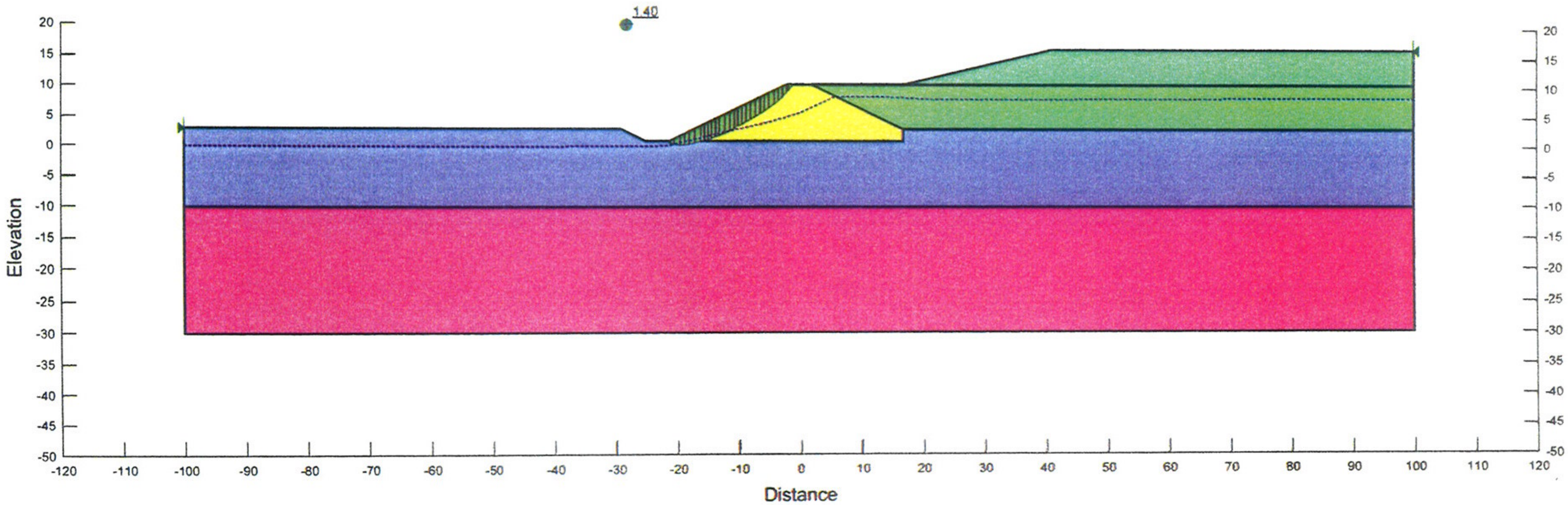

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Name: CH - Norfolk Model: Undrained (Phi=0) Unit Weight: 100 pcf Cohesion: 350 psf

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SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5

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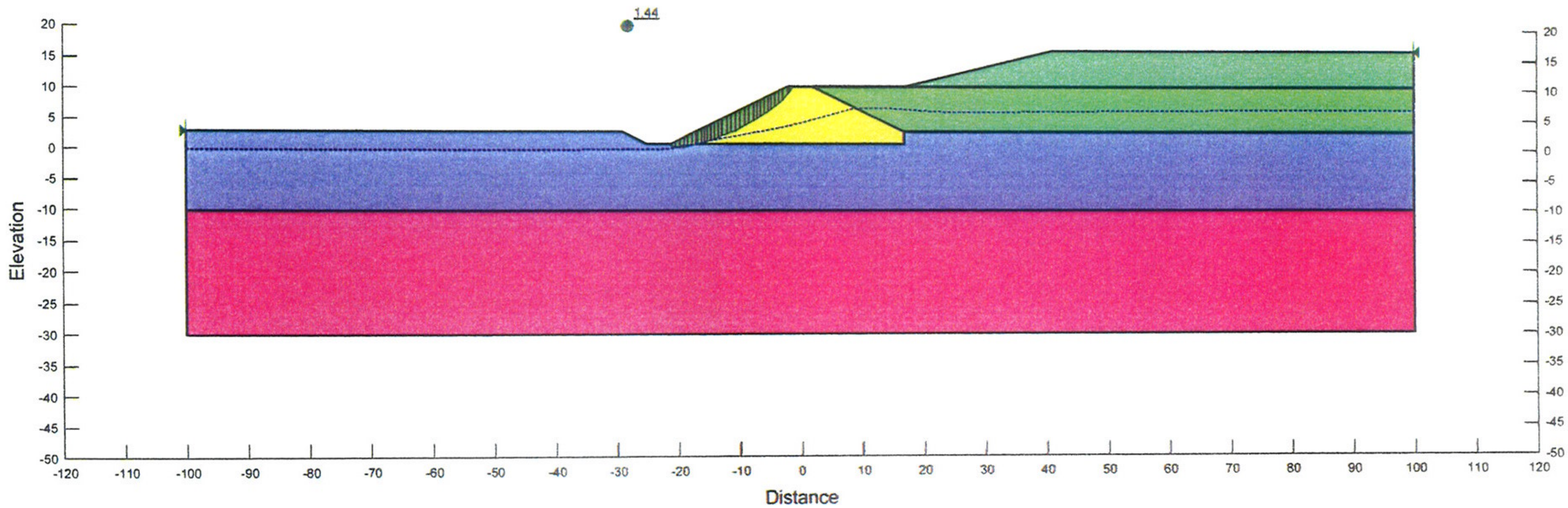

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Name: SM/SC Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34 °
Name: CH - Norfolk Model: Undrained (Phi=0) Unit Weight: 100 pcf Cohesion: 350 psf

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SECTION No. 1
Dredge Material at EL 10.5
Surcharge at EL 16.5

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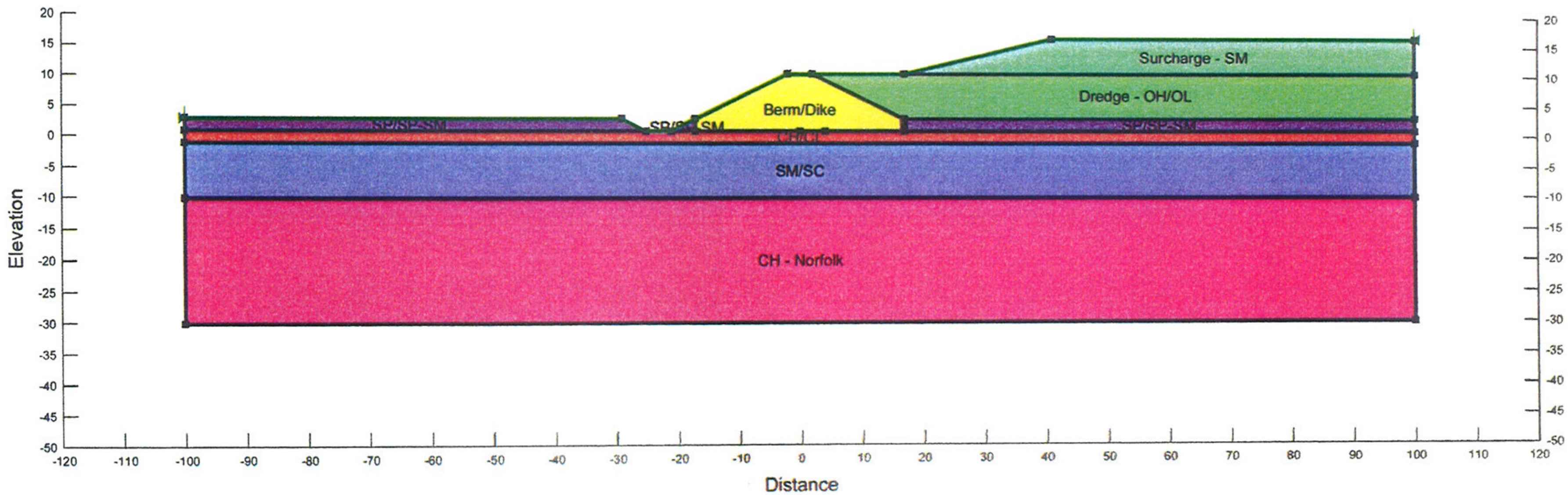

Name: Berm/Dike Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion: 500 psf
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Name: Surcharge - SM Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 38 °
Name: SM/SC Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34 °
Name: SP/SP-SM Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 34 °
Name: CH - Norfolk Model: Undrained (Phi=0) Unit Weight: 100 pcf Cohesion: 350 psf
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SECTION No. 2
Dredge Material at EL 10.5
Surcharge at EL 16.5

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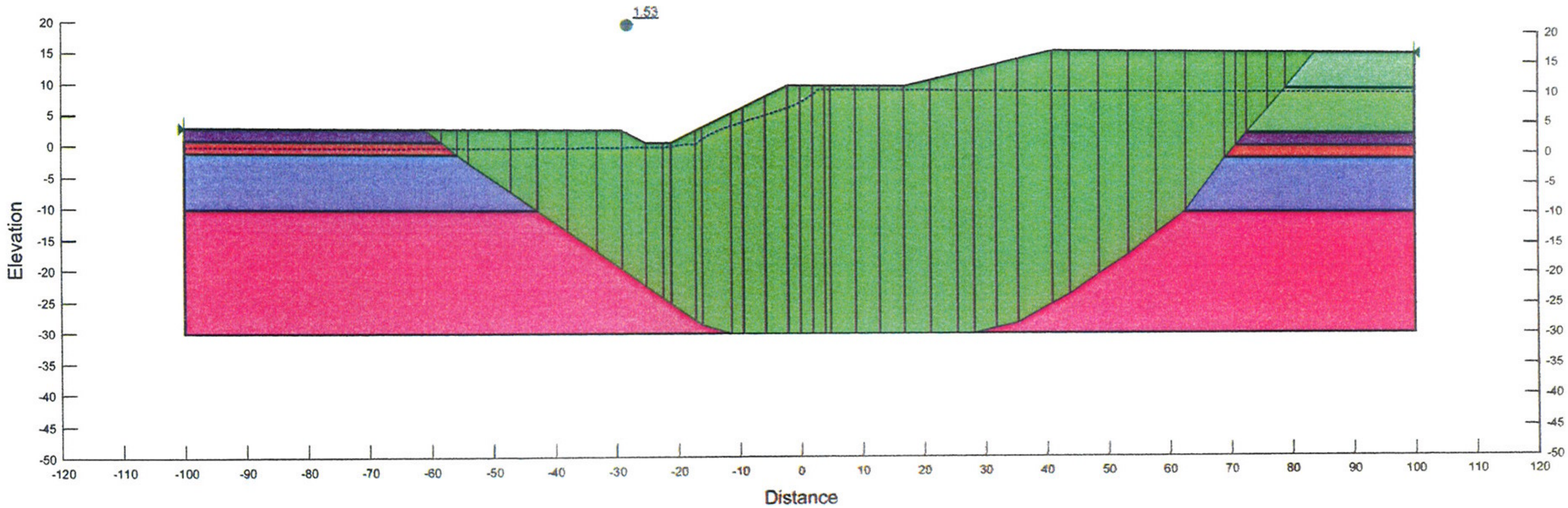

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Name: Surcharge - SM Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 38 °
Name: SM/SC Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34 °
Name: SP/SP-SM Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 34 °
Name: CH - Norfolk Model: Undrained (Phi=0) Unit Weight: 100 pcf Cohesion: 350 psf
Name: CH/CL Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion: 350 psf

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SECTION No. 2
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Surcharge at EL 16.5

File Name: Plate C2.2a-el10.0u.gsz
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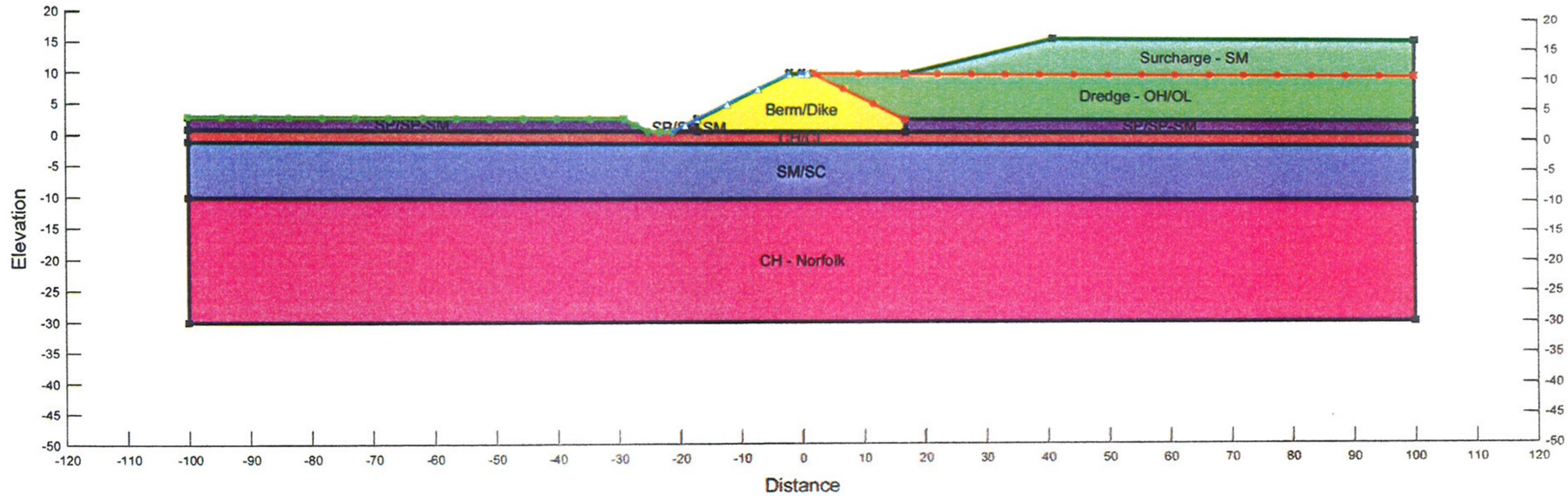

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Name: Surcharge - SM   Model: Saturated Only   K-Sat: 8.2e-007 ft/sec   Volumetric Water Content: 0 ft³/ft³   Mv: 0 /psf   K-Ratio: 1   K-Direction: 0 °
Name: SM/SC   Model: Saturated Only   K-Sat: 8.2e-007 ft/sec   Volumetric Water Content: 0 ft³/ft³   Mv: 0 /psf   K-Ratio: 1   K-Direction: 0 °
Name: SP/SP-SM   Model: Saturated Only   K-Sat: 3.3e-006 ft/sec   Volumetric Water Content: 0 ft³/ft³   Mv: 0 /psf   K-Ratio: 1   K-Direction: 0 °
Name: CH - Norfolk   Model: Saturated Only   K-Sat: 8.9e-008 ft/sec   Volumetric Water Content: 0 ft³/ft³   Mv: 0 /psf   K-Ratio: 1   K-Direction: 0 °
Name: CH/CL   Model: Saturated Only   K-Sat: 8.9e-008 ft/sec   Volumetric Water Content: 0 ft³/ft³   Mv: 0 /psf   K-Ratio: 1   K-Direction: 0 °

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SECTION No. 2
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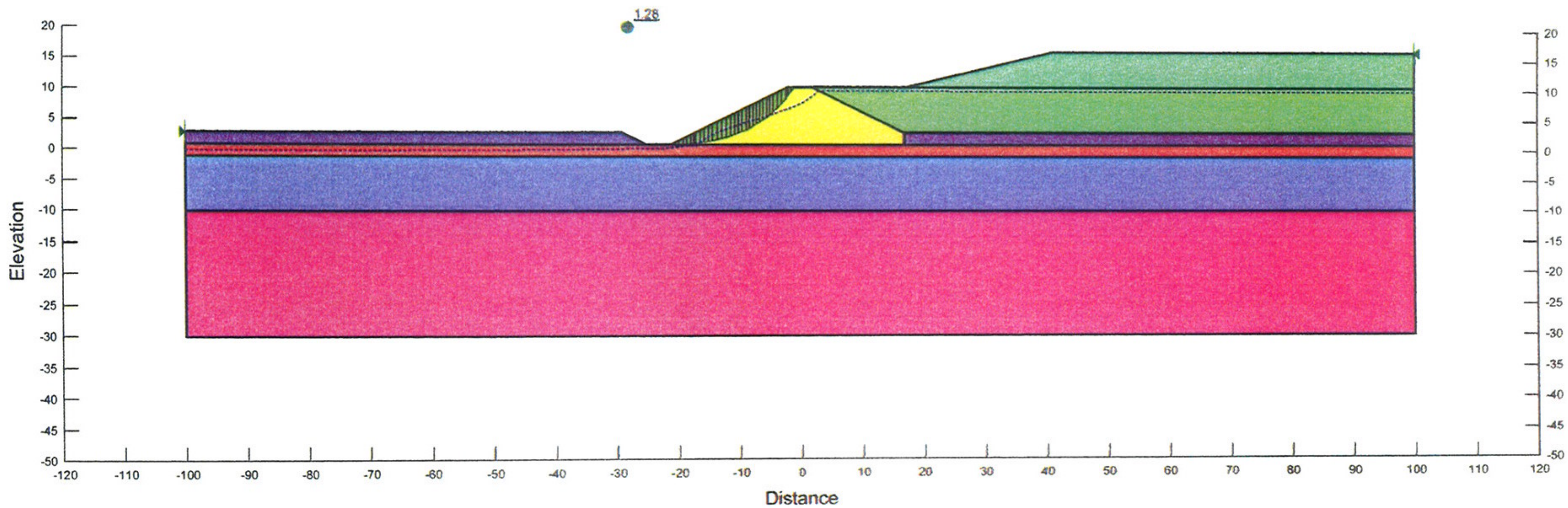
Surcharge at EL 16.5

File Name: Plate C2.2d.gsz
Name: Transient Seepage
Last Edited By: Scott Raschke
Date: 2/21/2011 Time: 4:23:14 PM
Directory: C:\Documents and Settings\sraschke\Desktop\AWI sensitivity analysis\Revisions 2011-02-17\Section 2\



Name: Berm/Dike Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion: 0 psf Phi: 32 °
Name: Dredge - OH/OL Model: Mohr-Coulomb Unit Weight: 90 pcf Cohesion: 0 psf Phi: 5 °
Name: Surcharge - SM Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 38 °
Name: SM/SC Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34 °
Name: SP/SP-SM Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 34 °
Name: CH - Norfolk Model: Undrained (Phi=0) Unit Weight: 100 pcf Cohesion: 350 psf
Name: CH/CL Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion: 350 psf

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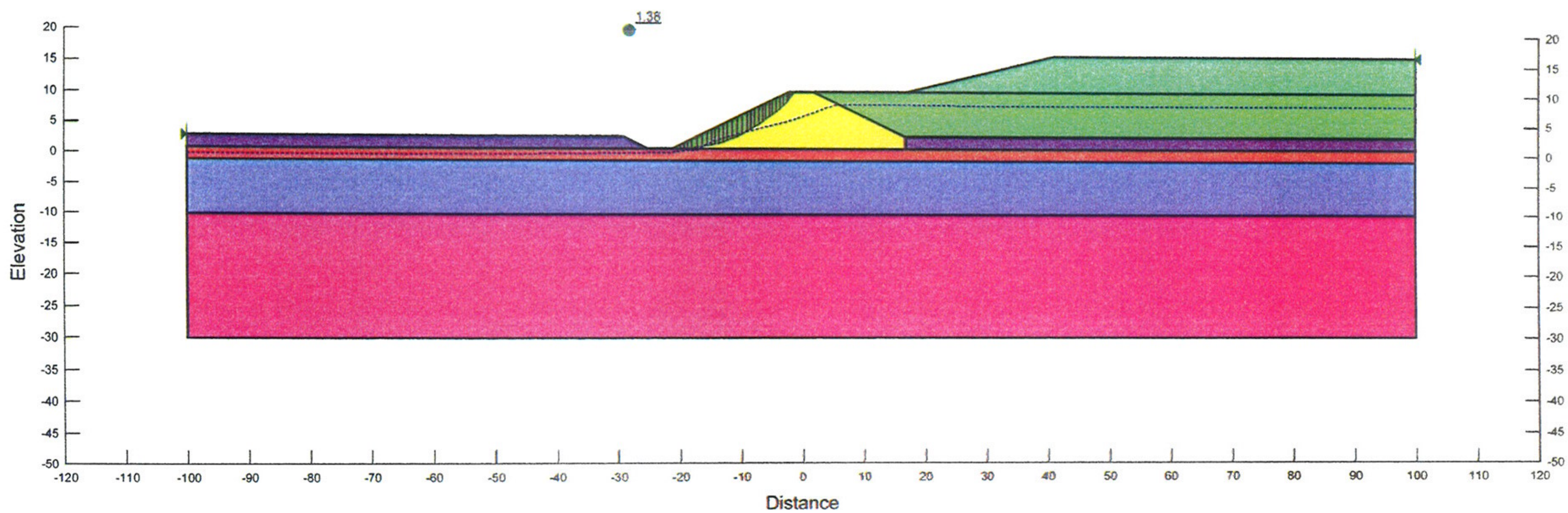
SECTION No. 2
Dredge Material at EL 10.5
Surcharge at EL 16.5

File Name: Plate C2.2a-el10.0d.gsz
Name: SLOPE/W Analysis
Last Edited By: Scott Raschke
Date: 2/21/2011 Time: 3:20:12 PM
Directory: C:\Documents and Settings\sraschke\Desktop\AWI sensitivity analysis\Revisions 2011-02-17\Section 2\



Name: Berm/Dike Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion: 0 psf Phi: 32 °
Name: Dredge - OH/OL Model: Mohr-Coulomb Unit Weight: 90 pcf Cohesion: 0 psf Phi: 5 °
Name: Surcharge - SM Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 38 °
Name: SM/SC Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34 °
Name: SP/SP-SM Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 34 °
Name: CH - Norfolk Model: Undrained (Phi=0) Unit Weight: 100 pcf Cohesion: 350 psf
Name: CH/CL Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion: 350 psf

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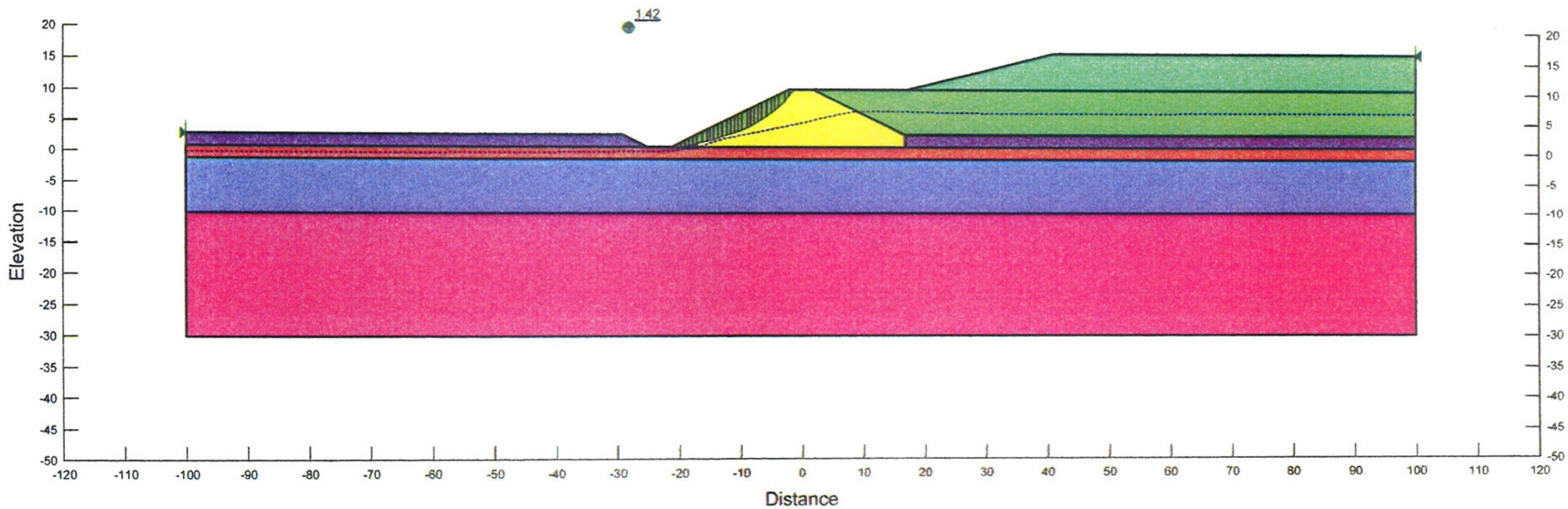
SECTION No. 2
Dredge Material at EL 10.5
Surcharge at EL 16.5

File Name: Plate C2.2b-el08.5d.gsz
Name: SLOPE/W Analysis
Last Edited By: Scott Raschke
Date: 2/21/2011 Time: 3:23:23 PM
Directory: C:\Documents and Settings\sraschke\Desktop\AWI sensitivity analysis\Revisions 2011-02-17\Section 2\



Name: Berm/Dike   Model: Mohr-Coulomb   Unit Weight: 105 pcf   Cohesion: 0 psf   Phi: 32 °
Name: Dredge - OH/OL   Model: Mohr-Coulomb   Unit Weight: 90 pcf   Cohesion: 0 psf   Phi: 5 °
Name: Surcharge - SM   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion: 0 psf   Phi: 38 °
Name: SM/SC   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion: 0 psf   Phi: 34 °
Name: SP/SP-SM   Model: Mohr-Coulomb   Unit Weight: 120 pcf   Cohesion: 0 psf   Phi: 34 °
Name: CH - Norfolk   Model: Undrained (Phi=0)   Unit Weight: 100 pcf   Cohesion: 350 psf
Name: CH/CL   Model: Undrained (Phi=0)   Unit Weight: 125 pcf   Cohesion: 350 psf

File Name: Plate C2.2c-el07.0d.gsz
Name: SLOPE/W Analysis
Last Edited By: Scott Raschke
Date: 2/21/2011 Time: 3:28:13 PM
Directory: C:\Documents and Settings\sraschke\Desktop\AWI sensitivity analysis\Revisions 2011-02-17\Section 2\

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SECTION No. 2
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Surcharge at EL 16.5